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VOLUME 7

1928

PUBLISHERS

AMERICAN MEDICAL ASSOCIATION

CHICAGO

Medical
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JANUARY, 1928

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second-Class Matter, January 14, 1925, at the Postoffice at Chicago, Illinois, under the Act of March 3, 1879. Acceptance for mailing at special rate provided for in Section 1103, Act of October 3, 1917, authorized January 22, 1925.

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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 7 JANUARY, 1928 NUMBER 1

TEACHING BRONCHOSCOPY AND ESOPHAGOSCOPY *

CHEVALIER JACKSON, M.D., Sc.D., LL.D.
PHILADELPHIA

Much has been written on the teaching of otolaryngology, but with the exception of a chapter and an abstract of it by myself, I have found nothing in the literature on the teaching or the training of the broncho-esophagoscopist.

When one considers the highly technical nature of bronchoscopy and esophagoscopy, the lack of literature is remarkable, and when one considers that fully half of the patients requiring these procedures are infants, the lack is deplorable; it becomes utterly so when it is realized that the lack leads the thoughtless to infer that training is not necessary. Hence occasionally, a surgeon who is accustomed to working in large open wounds and using both eyes and both hands, or a physician without even this manual training, telegraphs for a bronchoscope and puts it down the tender passages of an infant. Worse still is the attempt by an untrained man without trained assistants to insert an esophagoscope into an infant in search of a coin or a safety pin; he does not know that if an esophagoscope is put into the patient's pharynx and pushed downward, the one place into which it will *not* go is the esophagus.

For a long time I have realized this situation; but it has taken me twenty years to muster up the courage to present disagreeable facts. The time has come when the call is urgent; the occasion has come when I can do it among friends who will not misinterpret the motives. The demand of the times is for safe bronchoscopy. The staff of every large general hospital realizes the need of a bronchoscopic clinic, but the question arises, Who is capable of doing safe bronchoscopy?

The widespread and rapidly increasing interest of the members of the medical profession in the diagnostic and therapeutic value of bronchoscopy and esophagoscopy renders it necessary to face the fact that if these procedures are undertaken by the untaught, high and unnecessary mortality is sure to bring discredit on two important life-

* President's Address at the Meeting of the American Laryngological Association, Atlantic City, May 23, 1927.

saving procedures. The general practitioner, the internist and the surgeon, while recognizing the diagnostic and therapeutic helpfulness of these methods, realize that peroral endoscopy is a highly technical procedure, and that they do not have the time, even if they have the inclination, to acquire the skill and to drill and maintain the organization necessary for the safety and the utmost usefulness of bronchoscopy and esophagoscopy. But the members of the medical profession rightfully demand that when they submit a patient to the broncho-esophagoscopist, the latter shall have an adequate equipment, a well drilled personnel and a proper organization for doing the work safely with a maximum of good diagnostic and therapeutic results. Prof. Thomas McCrae [1] clearly expressed the views of the internist in addressing the Section on Laryngology, Otology and Rhinology of the British Medical Association.[1] His opinion on this subject is entitled to especial consideration because of his point of view, his clear vision, his long career as a teacher of medical science and his unique experience as an observer of clinical bronchoscopy and of bronchoscopists. He said:

> We have a right to ask that certain of you acquire such skill in bronchoscopy that we can refer patients to you with the assurance that they will be skilfully handled, and that, if necessary, a bronchcoscopy for diagnosis can be done with perfect safety.

When a bronchoscope is skilfully introduced into the laryngotracheobronchial airway or when an esophagoscope is introduced into the esophagus or stomach, there is no danger. On the other hand, when an otherwise skilful physician who has not been taught endoscopy starts to introduce either of these instruments into a dyspneic infant, the chances of the infant's survival are exceedingly remote. Any physician or surgeon can be taught to use these instruments safely; but he cannot learn by looking on at a clinic. In principle, the bronchoscope, the esophagoscope and the gastroscope are specula, but their introduction is highly technical as compared to the introduction of a vaginal or rectal speculum. If an esophagoscope is inserted into the pharynx and simply pushed downward, the one place it will *not* go is into the esophagus. Only a slight push is necessary to send it through the hypopharyngeal wall, where it will meet with less resistance in its progress down between the layers into the mediastinum than it would if it were going down inside the esophageal lumen.

Granting, then, that special training is necessary for those who expect to perform bronchoscopy and esophagoscopy, it seems proper to take up the problems connected with the teaching of these branches. Limitation of the field of work in any sort of endeavor always develops the best results. Undoubtedly, the otolaryngologist with his years of

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1. McCrae, Thomas: Foreign Bodies in the Air and Food Passages, Brit. M. J. **2**:693 (Oct. 17) 1925.

training in manipulations guided by only one eye has a good start on the road to safe and successful bronchoscopy. His knowledge of the larynx in health and disease is fundamental. These two facts warrant the statement that the laryngologist is the logical man to perform peroral endoscopy. A heavy burden of work has fallen on the bronchoscopist because of the remarkably high percentage of favorable results obtained by bronchoscopic aspiration in suppurative pulmonary disease of other than foreign body origin. As a result, the bronchoscopist is no longer the occasional operator he was in most instances in the days when patients were referred to him only for the removal of a foreign body. In the Philadelphia clinics the bronchoscopies performed for disease outnumber the bronchoscopies for foreign bodies tenfold. The same may be said of esophagoscopy. It becomes a serious question whether the otorhinolaryngologist of the future, burdened with diagnostic and therapeutic work in the consulting room and tonsillectomies, operations on the sinuses, mastoid, labyrinth and brain, will have the time required to assist the surgeon and the internist in the diagnosis and treatment of pulmonary disease.

It seems more likely that otologic and rhinologic operative work will be separated from that on the larynx. The development of a group of laryngologists specializing in endoscopy of the lungs, esophagus and stomach has already been started. The further development in this direction would reinstate the larynx to the place it occupied before the brilliant surgical achievements of otology and rhinology became so attractive that today most so-called laryngologists would more properly be called otorhinologists. Be this as it may, every one is, and should be, free to select his field of work; and the trend with a group of energetic capable laryngologists is toward limiting their field to laryngology, strictly speaking, combined with endoscopy of the trachea, bronchi, esophagus and stomach.

THE PROBLEM

Briefly stated, the fundamental problem is to teach the pupil how to put a rigid tube into the tender passages of an infant and to carry out certain complicated, potentially fatal manipulations with safety to the patient. The knowledge of how to perform bronchoscopy or esophagoscopy is not sufficient. As with all purely manual procedures, manual training is necessary.

Further study of this subject reveals many problems collateral to this fundamental one; in fact, the problems with which the teacher of bronchoscopy is confronted are greater and more numerous than might be supposed; and, as in other fields of education, they are much greater and more numerous in the case of some pupils than in that of others. The purely personal qualifications enter largely into the problem, and

the previous training may help or hinder the progress of the pupil. The man who has been well trained in the use of only one eye, with the microscope for instance, will have a start that will place him far ahead of a man who has always been accustomed to work with binocular vision. The man who has worked for a year or more in the training of one eye in examining mucosal surfaces under artificial illumination, and, additionally, in guiding instrumental manipulations under such limitations, has a still greater start. It is obvious that the otorhinologist has a good start. If he also has a good fundamental training in mirror study of the larynx, the broadest possible foundation will have been laid. Unfortunately, however, the brilliant achievements in surgical procedures on the ear and nasal accessory sinuses have proved so attractive that the larynx has been slighted to a considerable extent in the average postgraduate work in the special field usually referred to as the nose, throat and ear.

It seems to me that the intimate association, functionally and clinically, if not anatomically, between the upper and lower air passages, calls for thorough training in rhinology and laryngology before bronchoscopy is taken up. It is hard to conceive that any one who is not a laryngologist would attempt to pass a bronchoscope through the larynx.

The foregoing statements are not meant to discourage any one from learning to perform bronschoscopy and esophagoscopy; they are simply statements of facts that must be realized by the person who attempts to teach these procedures.

PERSONAL QUALIFICATIONS

The Personal Equation.—The practitioner or student often asks about the advisability of taking up the study of bronchoscopy. In some instances this has brought the fact forcibly to mind that some persons, entirely apart from scientific attainments, are much better adapted to acquire bronchoscopic dexterity than others. In a few instances it has been necessary to advise the applicant not to take the course in bronchoscopy because of personal disabilities; in still fewer instances, it has been necessary to refuse admission to applicants who insisted on taking the course against advice. It is a mistake to teach bronchoscopy to men who are physically or temperamentally ill-fitted for the work. Undoubtedly, there is a type of person better suited than another for the work. This does not mean that the best bronchoscopist is a man of superior intellect; on the contrary, too great intellectuality may be a drawback, though not an insurmountable one; nor does it mean that he must have physical superiority. The marvellous hand-forging of the expert iron worker requires as much manual skill as the making of the old hand-made Swiss watch, but the latter requires a different type of skill possessed by a different type of man. The man who can quickly and

skilfully remove an upper jaw will find excessive difficulty in tempering his muscles to the delicacy required for holding a peanut without crushing when removing it from the tiny bronchus of an infant. The heavy handed man is not the most promising raw material from which to make the safe bronchoscopist. Notwithstanding the truth of the foregoing statements, the essential fact remains that any person who recognizes the handicaps of his personal equation and who is willing to devote the time and the necessary concentration, can develop the skill necessary for safe bronchoscopy. But he must realize at the outset the fact so strongly emphasized by Joseph S. Wall, that all manipulations in infants must be gentle.

Eyes.—Good vision is essential. A high refractive error, if it can be brought fully up to twenty-twentieths by corrective lenses, is not a hindrance. Glasses of some kind must be worn to shield the eye not only from infection, but also from the otherwise inevitable blurring of the vision caused by the secretions and blood projected into the eye from the tube during coughing.

The glasses may as well be corrective lenses as merely protective plane glasses. The endoscopic test suggested many years ago seems a good one, namely, the ability to see and pick up black threads from a black cloth and white threads from a white cloth. This should be done with the infant size of tube and "mosquito" forceps. An applicant who can do this can be passed for admission to the class in bronchoscopy, so far as visual requirements are concerned.

Hands.—A "heavy-handed" man is handicapped until he trains his hands to delicacy of touch. A person with weak hands should use muscular exercises to increase the power of his fingers. Piano practice is excellent for this. The bronchoscopist should be as careful of his hands as is the pianist or the violinist. Care in the avoidance of infection, arthritis, myositis and trauma will help preserve digital skill. In work or play, care of the hands is necessary. The impact of the baseball is not conductive to tactile sensitiveness nor to nimble fingers. I would not be warranted in saying that the medical student who plays baseball cannot develop into a successful bronchoscopist; but if he does, he will long beforehand have abandoned ruining his hands.

Ambidexterity is a useful qualification for the endoscopist. There are times when he may wish for a third hand. The best substitute for this impossibility is to educate the left hand. Any one can educate the "lame duck." The left hand in right-handed persons or the right hand in left-handed persons can be trained, if not to equality with its better endowed fellow, at least to a degree that would have seemed marvellous at the beginning. As a boy, when a great degree of accuracy was not required in sawing a board, I forced my left hand to use the saw. Any one who says he cannot educate his "lame duck" simply is not willing

to make sufficient effort. Every automobile driver steers with his left hand while shifting gears. Every one learns to use a fork at table coordinately with the right handling of the knife; many shirk the education by first cutting the food ambidextrously and then transferring the fork to the right hand to pass the food to the mouth. This is a lost opportunity, and the loss in training is incalculably great in many manual procedures. The left hand, like the atypical child, needs encouragement, development and early training. Every child should be taught when first using a fork always to use it with the left hand. Careful watch should be kept to see that afterward the child is encouraged to do everything possible with the left hand. It is amusing, often pitiable, to see a surgeon unable to scrub his right hand and forearm properly because he has never educated the "lame duck." He will scrub his left hand skilfully, but when it comes to the right, he will rub the right hand on the brush. I am not advocating such a preposterous thing as that the training of the bronchoscopist or the surgeon must begin in childhood; but I feel that whether the child afterward becomes a surgeon or a bricklayer, he will never regret any effort expended on educating the left hand. Not having acquired ambidexterity in childhood, the bronchoscopist must do what he can to overcome his handicap, and it is astonishing what some pupils have accomplished in this direction even late in life.

Drill.—One of the fundamental purposes of drill in an army is to insure that when anything is to be done, it will be done with promptness and precision. Emergencies, for example, those at times arising in dyspneic patients, call for all possible promptness and precision if life is to be saved. Furthermore, if the patient enfeebled by acute pulmonary abscess, as for instance that following tonsillectomy, is to have the benefit of a life-saving bronchoscopic aspiration, it is necessary that the procedure be carried out with skill and precision and without a waste of time. If the patient with chronic suppurative disease of the lung is to have the benefit of the many times repeated bronchoscopic aspiration, the procedure must be done with promptness and precision and with the least possible discomfort. Nothing but a well drilled team of three can fill the need in these cases. Bronchoscopy is not a "one-man job." Every step of each procedure must be drilled into each member of the personnel when the pupil establishes his own clinic. To drill his team he must himself be drilled in the duties of each of the two assistants, the one who hands him the instruments and the one who holds the head. A third assistant must be trained to hold down the shoulders, but this duty is more quickly learned.

Must the Pupil Be Taught to Work Without Anesthesia?—It seems necessary that the pupil should be taught to examine the larynx with the

direct laryngoscope without general or local anesthesia in order that the practitioner may unhesitatingly call on him to examine the larynx of a croupy child suspected of having diphtheria. Because of the great dangers attending the use of anesthesia in cases of obstructive laryngeal dyspnea, he must also be prepared to perform not only direct laryngoscopy and bronchoscopy, but also esophagoscopy. This danger is present independent of the procedure, but the danger may be enormously increased by endoscopic manipulation however skilfully performed. This applies with especial force to esophagoscopy performed in very young children.

For patients who are dangerously ill, such as many of those with posttonsillectomic pulmonary abscess, general anesthesia would be undesirable; also in chronic suppurative diseases of the lungs the frequently repeated bronchoscopic aspirations preclude the use of general anesthesia; therefore the pupil must be taught how to work without anesthesia. It is not necessary that he be told to avoid the use of a general anesthetic in all his future work. But it may be added that in the bronchoscopic clinic of the Graduate School of Medicine of the University of Pennsylvania all of the pupils while under instruction work without general anesthesia, because it is never used in this clinic. So far as it is known, these students do not resort to it in their future work. They are always told to be guided solely by what they deem to be best for the patient.

Preliminary Training.—As with all purely manual procedures, education of the eyes and fingers is essential to success; in peroral endoscopy, it is also essential to the safety of the patient. Any one who regards it beneath his dignity preliminarily to educate his eyes and fingers in the technic of operation for cataract by practice on the eyes of butchered animals had better not attempt the operation on a living human being. The dead eye affords better preliminary practice because work on it is not accompanied by anxiety or stress. The operation for cataract is performed under binocular control. Peroral endoscopy is done under monocular control, which not only is unusual, but also involves perception of depth with one eye; this is difficult to acquire to a useful degree, and impossible to acquire to perfection. Nothing will take the place of education of the eye *at the endoscopic tube.* Fortunately, a rubber tube manikin affords an easy, handy, carefree, always ready means of education of the eye and the fingers to the peculiar requirements of the work. With a little training on the cadaver as to the dangers to be avoided and how to avoid them, and on the dog for the problems presented by the movements of the living bronchi, the man who will use his spare moments for manipulating various foreign bodies in a rubber tube under guidance of the eye will soon make a safe and

successful bronchoscopist. Without preliminary training, it is brutal to attempt to acquire skill by work on living human beings, and the attempt is usually unsuccessful because the anxiety and stress are too great and the time is too short.

Training on the Cadaver.—The cadaver serves five essential purposes in the training of the peroral endoscopist as indicated in the following.

1. On it he learns to identify landmarks. It is vitally necessary for the endoscopist to know throughout his examination the exact location of the tissue presenting at the mouth of the tube. The only way he

Fig. 1.—Teaching bronchoscopy and esophagoscopy at the Ecole de Médecine, Université de Paris, in the laboratory of Professor Cuneo. These courses were arranged in collaboration with Professor Sebileau. The class was divided into groups of three men to each cadaver, each man taking turns as endoscopist, first assistant and second assistant. Landmarks, endoscopic anatomy, danger points, position of the patient and all the technical manipulations were taught and drilled into the pupil in a way that would be inhuman if not impossible on the living.

can know this is by identification of the anatomic landmarks encountered in the larynx, trachea, bronchi, hypopharynx, esophagus and stomach.

2. Endoscopic anatomy may be studied on the cadaver. Identification of the landmarks includes, of course, the study of endoscopic anatomy, but it seems wise to emphasize the identification of landmarks, not only because of the importance of this identification at every

endoscopy, but also because no part of the instruction in endoscopic procedures is more generally disregarded.

3. In no way other than by the use of the cadaver can the difficulties created by faulty position be contrasted with the advantages of the proper position.

4. In no other way can the pupil be so well taught the location of the danger points, the dangers of faulty position and of improper instrumentation.

5. The pupil not only must know the proper position of the patient, the serial identification of the landmarks and the proper methods of

Fig. 2.—Teaching bronchoscopic and esophagoscopic removal of foreign bodies from the living, moving air and food passages of narcotized dogs at the Université de Paris, in conjunction with the International Courses established by Dr. Fernand Lemaitre, Professeur Agrégé à la Faculté de Médecine, and oto-rhino-laryngologiste à l'Hôpital Saint-Louis. The class was divided into groups of three men to each dog, each man in turn serving as endoscopist, first assistant and second assistant. Each pupil was trained in technic as well as taught the difficulties, dangers and best solution of the problems presented by tacks, safety-pins and all classes of foreign bodies.

instrumentation, but he must be drilled in these essentials until they become matters of routine, almost of "nerve-cell habit." By the following of the same routine in the operating room, instead of confusion and useless movements which waste time, every man knows his duty and does it smoothly, quietly and efficiently. This minimizes the duration

of the procedure and the discomfort of the patient, factors of utmost importance in the frequently repeated endoscopies for chronic disease and in endosopy performed on patients who are critically ill and on whom it is unjustifiable to do a bronchoscopy unless it can be performed quickly and without becoming an ordeal. Most important of all, perhaps, is the promptness and precision with which everything is done in meeting those emergencies that not infrequently occur in dealing with patients in whom obstructive dyspnea occurs.

Practice on the Dog.—Much misconception exists as to the place of the dog in the teaching of bronchoscopy. The dog is of little use in teaching the introduction of instruments. Practice on the dog is invaluable in: (*a*) education of the eye to the normal bronchoscopic image; (*b*) education of the eye to the normal movements of the living tracheobronchial tree and (*c*) practice in the mechanical problems in the extraction of foreign bodies. It is a platitude to say that the histopathologist must know the normal microscopic appearances; he not only must know them, but must also be so familiar with them that any abnormality immediately attracts his attention. Yet the parallel requirements as to the normal bronchoscopic appearances are not so generally recognized. The bronchoscopist must also be equally familiar with the normal movements of the tracheobronchial tree. Departures from normal movements and absence of movements are two of the most important elements in bronchoscopic diagnosis.

It is, of course, unthinkable to put a safety-pin in the bronchi of a living child for practice in removal. Even if this preposterous thing were done, but little useful practice could be obtained, because endoscopic work on children involves too great a degree of stress. Much better training can be obtained by removing the safety-pin and other objects from the living moving bronchi of the dog.

How else can it be obtained?

It certainly cannot be obtained to an adequate degree in a lifetime of clinical bronchoscopic work, because few bronchoscopists are likely to have a sufficient number of cases. Hundreds of cases of bronchially lodged foreign bodies can be created at will on the dog. Any one who objects to the use of the dog for this purpose should ask himself this question: If a safety-pin had to be removed from the bronchus of my own child and I had to choose between two experienced men to perform the operation, would I choose a man who had never removed a safety-pin or one who had removed a safety-pin a hundred times from the living, moving bronchus of a dog? To answer that he would get an experienced man is equivalent to advising practice on the child of someone else rather than on the dog. Of course, the dog is entitled to every humane consideration; from this as well as other points of view, it is essential that preliminary practice on the rubber tube and cadaver precede endoscopic work on the dog. The dog should be

anesthetized. Morphine, in dosage of 1/6 grain (0.01 Gm.) per pound of body weight of the dog, has proved a satisfactory drug for this purpose. Anhydro-gluco-chloral, a synthetic product prepared from glucose and anhydrous chloral, is also a good anesthetic and has a property which is desirable in this work. It produces not only complete anesthesia and unconsciousness, but also slight exaggeration of the reflexes. The latter condition simulates perfectly endoscopic work on the unanesthetized child.

Clinical Work.—It is essential to have training on the living human being also; but pupils in this clinic are never permitted to attempt to introduce a bronchoscope or esophagoscope until they have had at least two weeks of intensive training in removing an obstruction from the rubber tube, the dog and the cadaver. Most of these pupils have been practicing otorhinology for years and have had hundreds of hours of practice in perception of depth with one eye. In the case of a man with only the training of a surgeon, who performs operations that require the use of both eyes and both hands in dealing with open wounds, a longer period of preliminary practice in removing a foreign body from the rubber tube is essential even to make him proficient in performing endoscopy for disease unconnected with obstruction by a foreign body. The first endoscopies on human beings should be performed on adults; later, they should be performed on older children; only after prolonged practice and experience is it justifiable to put an endoscopic tube into the tender passages of an infant. Practice is required to execute the manipulations of introduction of the instruments. After skill in introduction is acquired, education of the eye to the endoscopic appearances in health and disease is essential for diagnosis. To recognize disease, it is necessary that the eye be trained to recognize the normal endoscopic image as to (*a*) form, (*b*) color and (*c*) movements (McCrae, Funk, Jackson) until any departure from normal is instantly perceived. This degree of training is quickly obtained by the man who has already trained his eye and perceptive faculties on the living dog.

Direct Laryngoscopy.—Exposure of the larynx to view is the first step in bronchoscopy. It is therefore necessary for the pupil to master thoroughly direct laryngoscopy before attempting to perform bronchoscopy. The larynx of any human being who can open his mouth can be exposed to direct view, provided the essentials of position and manipulation have been mastered. This training is carried out by thorough drill on the cadaver until all of the movements are made in proper sequence and are practically automatic. If this is not done, the pupil will inevitably drift into a faulty technic that will always be a handicap. Among other faults, he will inevitably get the habit of trying to pry open the larynx instead of lifting it open; another fault will be the use of the right hand to hold the laryngoscope. When these

pernicious habits are acquired, endless training is necessary to eradicate them. It is easier to expose the larynx with the left hand than with the right when this has been learned.

Introduction of the Bronchoscope.—Drill with the instruments always in the proper position and handled in a definite routine should be insisted on, and it must follow precisely the technic previously drilled into the pupil when he was practicing on the cadaver.

Introduction of the Esophagoscope.—In introducing the esophagoscope it is extremely difficult for the instructor to safeguard the patient against instrumental trauma. If, however, the training on the cadaver has been thoroughly carried out and the pupil is not too heavy-handed, there will be no danger. The first esophagoscopies should be performed on elderly, relaxed patients who have long necks.

SUMMARY

1. Systematic instruction in direct laryngoscopy, bronchoscopy, esophagoscopy and gastroscopy is essential for the safe performance of these procedures.

2. If bronchoscopy for diagnosis and treatment of pulmonary disease is to have the full measure of application that its life-saving usefulness merits, those who perform this operation must be taught and drilled so thoroughly that danger is eliminated and the duration of the procedure and the discomfort to the patient are minimized.

3. Preliminary training on the rubber tube manikin should be the first stage of the instruction.

4. The cadaver should be used to teach: (*a*) seriatim identification of landmarks; (*b*) endoscopic anatomy; (*c*) the position of the patient, contrasting faulty with correct positions; (*d*) dangers and how to avoid them; and (*e*) for the purpose of drill, the pupil being trained in all the procedures of introduction of instruments, use of forceps, etc., until a condition of "nerve-cell habit" is created. Work on the cadaver should also include practice in the solution of all the important mechanical problems of the disimpaction of foreign bodies, disentangling, version and conversion of unfavorable into favorable presentations.

5. Practice on the dog should be thoroughly carried out for the study of the normal color, form and movements of the larynx, the tracheobronchial tree, the hypopharynx, the esophagus and the stomach. Practice in the manipulations of foreign bodies should include all the recognized problems and their solutions.

6. Clinical work should not be attempted until after the pupil has had at least sixty hours of preliminary training on the rubber tube, cadaver and dog. One hundred hours of preliminary training are desirable.

THE PATHOLOGY OF MASTOIDITIS IN INFANTS*

BERNARD J. McMAHON, M.Sc., M.D.
ST. LOUIS

The fact has been established [1] that there is a definite clinical relationship in infants between otitis media and mastoiditis and certain systemic manifestations, such as increased temperature, diarrhea, vomiting, loss of weight and athrepsia. In a certain number of these patients, the performance of either a unilateral or a bilateral mastoidectomy, in which free postauricular drainage has been established and maintained until all symptoms of involvement of the middle ear and mastoid have subsided has brought about marked improvement and eventually complete recovery.

I was especially interested in seeking an aedquate explanation of this phenomenon in the microscopic changes that the mastoid tissue had undergone during the course of these infections. With this in mind, I have examined the material removed from seventy-one infant mastoids —thirty-nine patients. The operations were performed by Dr. H. W. Lyman, Dr. L. E. Freimuth and myself at the St. Louis Children's Hospital from September, 1926, until May, 1927.[2]

These mastoidectomies, or antrotomies as they are more accurately called, for, structurally, there is scarcely more than an antrum present in infants, accomplished three purposes: bone was removed, pathologic tissue and secretions were exenterated and drainage from the middle ear was established.

In setting forth these observations, I realize fully that thirty-nine cases are too few from which to draw final conclusions. For that reason,

* From the Department of Otolaryngology, Washington University School of Medicine.

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TABLE 1.—*Data on Pathologic Changes in Class 1*

Age	Side	Macroscopic Examination	Microscopic Examination	Bacteriology	Interval Between Onset and Operation	Interval Between Operation and Discharge	Result
11 months	Right	Antrum: free pus; mucosa: thickened and pyogenic	Bone: cartilagenous, marked fragmentation along edges; slight necrosis in places; interspaces: marked increase in young connective tissue cells; vessels: congested; periosteum: moderately thickened; mucosa: edematous, infiltrated with young connective tissue cells and red blood cells	Cultures lost	5 days	2 days	Died
	Left	Antrum: no frank pus; mucosa: thickened; infected cells along squamopetrosal suture	Bone: cartilagenous, marked fragmentation along edges, slight necrosis in places; interspaces: normal; periosteum: slightly thickened; mucosa: edematous, marked infiltration with young connective tissue cells, polymorphonuclears and red blood cells, much free blood				
5 months	Right	Antrum: frank pus...	Bone: cartilagenous with early absorption of calcium in places; interspaces: moderate increase in young connective tissue cells; periosteum: normal; mucosa: edematous, moderate young connective tissue cells and polymorphonuclear infiltration, early fibrosis in few places, much free blood	Gram-negative bacillus and diphtheroid	5 weeks	17 hours	Died
	Left	Antrum: free pus....	Bone: cartilagenous with early absorption of calcium in places; periosteum: normal; mucosa: edematous, marked infiltration with young connective tissue cells, much free blood	Nonhemolytic staphylococcus			
1 month	Right	Antrum: infected granulations	Bone: cartilagenous, except for some areas of early necrosis along edges; interspaces: normal; periosteum: extremely thickened; mucosa: markedly thickened and infiltrated with young connective tissue cells and polymorphonuclears	Diphtheroid; B. coli, nonhemolytic and Staphylococcus aureus	12 days	7 weeks	Died
	Left	Antrum: thick stringy pus	Bone: moderate generalized absorption of calcium, and necrosis; interspaces; some increase in young connective tissue cells; mucosa: extremely edematous and markedly infiltrated with young connective tissue cells, polymorphonuclears and red blood cells	Pneumococcus type 2			
5½ months	Right	Antrum: very small; mucosa: thickened and pyogenic; lateral sinus: far forward	Bone: normal; interspaces: normal; periosteum: moderately thickened; mucosa: edematous, markedly infiltrated with young connective tissue cells, polymorphonuclears and red blood cells	No growth	2 weeks	4½ months	Improved

	Left	Antrum: usual size, filled with infected granulation tissue	Bone: mild generalized absorption of calcium, moderate fragmentation necrosis along edges; interspaces: slight increase in young connective tissue cells; periosteum: moderately thickened; mucosa: thickened, edematous, marked infiltration with connective tissue cells, polymorphonuclears and red blood cells	No growth			
6 months	Right	Antrum: frank pus...	Bone: normal except for moderate fragmentation along edges and very early absorption of calcium; interspaces: vessels congested; periosteum: slightly thickened; muosa: thickened, marked infiltration with young connective tissue cells and polymorphonuclears, some free blood	Pneumococcus type 4; Micrococcus catarrhalis; Staphylococcus albus	3+ days	3 weeks	Improved
	Left	Antrum: frank pus...	Bone: normal, some fragmentation along edges; interspaces: moderate increase in young connective tissue cells; periosteum: moderately thickened; mucosa: extremely edematous and infiltrated with young connective tissue cells, polymorphonuclears and red blood cells	Pneumococcus type 4			
2½ months	Right	Antrum: pus under pressure	Specimens lost	Pneumococcus type 1	7+ days	2 days	Died
	Left	Antrum: pus under pressure	Bone: unusually compact; interspaces: increase in young connective tissue cells with fibrosis in many; periosteum: slightly thickened; mucosa: marked infiltration with polymorphonuclears in places	Pneumococcus type 1			
9 months	Right	Antrum: thick ropy pus, grayish infected granulations	Bone: normal except for moderate absorption of calcium in places; interspaces: normal; periosteum: extremely thickened in places; mucosa: moderate edema with slight infiltration of young connective tissue cells and some polymorphonuclears	No growth	3 weeks	6 days	Died
	Left	Antrum: thick ropy pus, grayish infected granulations	Bone: normal; interspaces: moderate increase in young connective tissue cells, free blood cells in places; periosteum: moderately thickened; mucosa: moderate edema with slight infiltration of young connective tissue cells and some polymorphonuclears	Nonhemolytic staphylococcus			
11 months	Right	Antrum: filled with stringy mucopus and polypoid mucosa curetted	Bone: normal except for few areas of absorption of calcium; interspaces: normal; periosteum: moderately thickened; mucosa: edematous and infiltrated with young connective tissue cells, polymorphonuclears and red blood cells	Stretpococcus hemolyticus	7 days	1 month	Died
	Left	Antrum: large, uncapped only	Bone: normal, cartilagenous in some places, older in others, early absorption of calcium in others; interspaces: normal; periosteum: moderately thickened; mucosa: early fibrosis with some edema in places	Streptococcus hemolyticus			

I wish this to be considered as only a preliminary report, to be used as a guide in future investigations.

PREPARATION OF TISSUE

The mastoid chips and curettings were placed in 10 per cent solution of formaldehyde immediately after operation and fixed for twenty-four hours. The fragments were then placed in a decalcifying solution composed of 150 cc. of absolute alcohol, 150 cc. of tap water and 15 cc. of concentrated hydrochloric acid, and left in this solution until the bone was soft. These were then washed

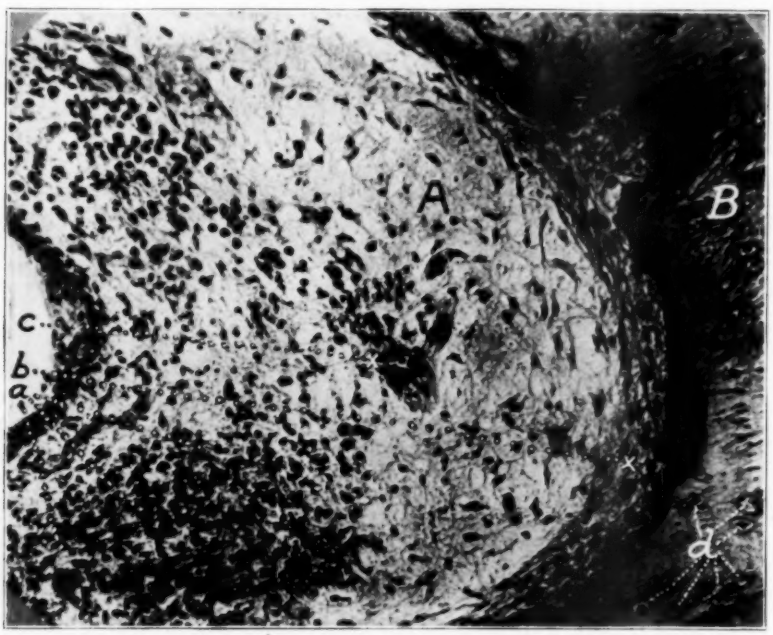

Fig. 1.—Edema of mucosa in classes 1 and 2. *A* indicates the mucosa; *a*, the young connective tissue cells and polymorphonuclear; *b*, young connective tissue cells among which calcium is being laid down; *c*, red blood cells and polymorphonuclears in blood capillary; *B*, bone, and *d*, young bone cells.

in tap water for twenty-four hours, dehydrated, embedded in paraffin and cut and stained with hematoxylin (Harris') and eosin.

I have divided the cases into four classes or types, according to the clinicopathologic picture.

Class 1.—In eight cases or 20.5 per cent, all patients showed one or more of the symptoms of increased temperature, diarrhea, vomiting, loss of weight and athrepsia. All had bilateral otitis media, and free pus or thickened mucosa or both were found in the antrums and removed.

The microscopic picture presented was principally a thickened, edematous mucosa with more or less marked infiltration by polymorphonuclears, young connective tissue cells and red blood cells. The changes in the bone, consisting of some fragmentation and varying degrees of absorption of calcium, suggestive of mild necrosis, were so irregular that they could not be considered pathognomonic (figs. 1, 2 and 3).

Six of these patients died and two recovered. Of these, one had a recurrence of the otitis media without general symptoms within six weeks.

The mortality in this group was 75 per cent.

CLASS 2.—In six cases, or 15.4 per cent, none of the patients showed any of the clinical symptoms enumerated under class 1 except the increased temperature, slight loss of weight and otitis media. The observations at operation and the microscopic pictures were identical with those of the cases in class 1.

There was only one death, which was caused by a fulminating neoplastic condition of the cervical lymphatics. The other five patients recovered completely. There were no recurrences.

The mortality in this group was 16.6 per cent.

CLASS 3.—In fourteen cases, or 35.9 per cent, all patients showed one or more of the clinical symptoms enumerated under class 1. All had a unilateral or bilateral otitis media for which the infant had been treated as a routine by repeated incisions of the membrana tympani and irrigations. In all of them free pus, in many instances under pressure, and thickened mucosa were encountered and removed from the antrums.

The microscopic picture was consistently a fibrosis of the mucosa in the early or advanced stages, with more or less infiltration by polymorphonuclear leukocytes and nonpathognomonic changes in the bones.

There was no mortality. There was only one recurrence of the otitis media; this necessitated a recuretting of both antrums four months later. All infants eventually recovered (fig. 3).

CLASS 4.—In eleven cases, or 28.2 per cent, none showed the symptom complex enumerated in classes 1 and 3, except rise in temperature, some loss of weight, otitis media and mastoiditis, being clinically analogous to class 2.

The observations at operation and the microscopic pictures were identical with those encountered in the cases in class 3.

Two of the patients died. One was moribund when brought into the hospital, and operation was performed immediately as an heroic measure. The other patient succumbed to bronchopneumonia. There was one recurrence of the otitis media; the other patients eventually recovered.

The mortality in this group was 18.2 per cent.

MORTALITY AND RECOVERY

The "diarrhea-vomiting complex" occurred in twenty-two and was absent in seventeen patients. Twice as many patients died in the group that had diarrhea.

Microscopic edema of the mucosa occurred in fourteen and fibrosis in twenty-five patients. More than three times as many patients died in the group that had edema.

TABLE 2.—*Data of Pathologic Changes in Class 2*

Age	Side	Macroscopic Examination	Microscopic Examination	Bacteriology	Interval Between Onset and Operation	Interval Between Operation and Discharge	Result
5½ months	Right	Bone: spongy, bled freely; antrum: filled with mucus, grayish granulations and thickened mucosa	Bone: occasional small areas of early rarefaction; interspaces: normal; periosteum: slightly thickened; mucosa: marked edema, fibrous and lymphocytic infiltration in various places	Diphtheroid, nonvirulent to guinea-pigs	2 weeks	3 weeks	Improved
	Left	Bone: spongy, bled freely; antrum: filled with mucus, grayish granulations and thickened mucosa	Bone: occasional small areas of early rarefaction; interspaces: normal; periosteum: slightly thickened; mucosa: marked edema, fibrous and lymphocytic infiltration, in various places	No growth			
6 months	Right	Antrum: small and deep, much pus under pressure, small amount of mucus; cells of cortex not necrotic	Bone: cartilagenous except for slight necrotic changes in places; interspaces; marked infiltration by connective tissue cells generally; mucosa: marked edema, young connective tissue cells and infiltration by polymorphonuclears in clumps	Staphylococcus hemolyticus	7 days	3 weeks	Died
	Left	Antrum: unusually large, much pus under pressure, large amount of polypoid granulations extending into tip	Bone: cartilagenous except for moderate necrotic changes in places; interspaces: marked infiltration by connective tissue cells generally; mucosa: marked edema, young connective tissue cells and polymorphonuclears in clumps	Staphylococcus hemolyticus			
13 months	Right	Antrum: free pus under pressure; moderate amount of destruction of bone	Bone: moderate to far advanced necrotic changes in a few places; interspaces: normal; mucosa: extremely edematous, moderate infiltration by polymorphonuclears and red blood cells in places, some increase in connective tissue cells	Streptococcus hemolyticus	5+ days	5 weeks	Improved

10 months	Right	Antrum: pus under pressure near surface; infected cells along root of zygoma	Bone: nuclei absent in places; moderate infiltration with young connective tissue cells along edges, marked absorption of calcium along edges preceding invasion by connective tissue cells; interspaces: marked fibrosis; periosteum: extremely thickened; mucosa: edematous, and infiltrated with polymorphonuclears, many gland ducts seen	Streptococcus hemolyticus	1+ day	10 weeks	Improved
23½ months	Right	Antrum: filled with hyperplastic mucosa and sticky mucopus, a similar substance filling all cells from tip to base of zygoma; cells: necrotic; cortex: sclerotic	Bone: cartilagenous with mild absorption of calcium in places; interspaces: marked increase in young connective tissue cells; periosteum: slightly thickened; mucosa: marked edema and infiltration with young connective tissue cells, polymorphonuclears and red blood cells	Staphylococcus hemolyticus	5 weeks	2 weeks	Improved
	Left	Antrum: filled with hyperplastic mucosa and sticky mucopus, a similar substance filling all cells from tip to base of zygoma; cells: necrotic; cortex: sclerotic	Bone: cartilagenous with mild absorption of calcium in some places and moderate necrotic changes and fragmentation in others; interspaces: marked increase in young connective tissue cells; periosteum: slightly thickened; mucosa: marked edema and infiltration with polymorphonuclears and red blood cells	Staphylococcus hemolyticus			
10 months	Right	Antrum: deep, pus under pressure, lined with thickened mucosa	Bone: moderate absorption of calcium in places, otherwise normal; interspaces: normal; periosteum: extremely thickened; mucosa: edematous with moderate infiltration by young connective tissue cells and marked infiltration by polymorphonuclears in places	Cultures lost	2+ days	10 weeks	Improved
	Left	Antrum: deep, pus under pressure, lined with thickened mucosa	Bone: normal except for early moderate absorption of calcium in places; interspaces: normal; periosteum: extremely thickened; mucosa: edematous with moderate infiltration by young connective tissue cells				

TABLE 3.—*Data of Pathologic Changes in Class 3*

Age	Side	Macroscopic Examination	Microscopic Examination	Bacteriology	Interval Between Onset and Operation	Interval Between Operation and Discharge	Result
3 weeks	Right	Antrum: pus under pressure; reopening four months later; infected granulatons protruding through original opening, no attempt at bone regeneration; antrum: stringy pus under slight pressure	Bone: cartilagenous with moderately advanced absorption of calcium and some fragmentation at edges; interspaces: slight increase in young connective tissue cells; periosteum: moderately thickened; mucosa: marked infiltration by young connective tissue cells, polymorphonuclears and red blood cells, with moderate fibrosis	Pyocyaneus, Staphylococcus aureus, nonhemolytic streptococcus	8 days; second operation 3 months later	5 months 1 month	Improved Improved
	Left	Antrum: pus under pressure; reopening four months later; cortex had grown over original opening; antrum: filled with stringy pus and granulations	Bone: cartilagenous with moderate absorption of calcium in places; interspaces: marked increase in young connective tissue cells; mucosa: marked infiltration by young connective tissue cells, polymorphonuclears and red blood cells	Pyocyaneus			
11 months	Right	Antrum: large, filled with mucopus and granulations	Bone: cartilagenous, absorption of calcium in places; periosteum: normal; mucosa: increase in young connective tissue cells	Cultures lost	2 months	5 weeks	Improved
	Left	Antrum: large, filled with mucopus and granulations	Bone: normal except for some absorption of calcium, and early necrosis in places; periosteum: moderately thickened; mucosa: infiltrated by connective tissue cells with early fibrosis, free blood in places				
7 months	Right	Antrum: contains thick stringy mucopus	Bone: slight generalized tendency toward vacuolization, indicative of early absorption of calcium; interspaces: moderate increase in young connective tissue cells; periosteum: moderately thickened; mucosa: marked infiltration with free blood, young connective tissue cells and some polymorphonuclears	Pneumococcus type 3	2 weeks	9 weeks	Improved
	Left	Antrum: contains thick stringy mucopus	Bone: slight generalized tendency toward vacuolization, signs of early absorption of calcium; interspaces: slight increase in young connective tissue cells; mucosa: moderate infiltration of young connective tissue cells, with early fibrosis	Pneumococcus type 3	2 months	9 weeks	Improved
6 months	Right	Antrum: no frank pus; bone slightly necrotic	Bone: early rarefaction in places, otherwise normal; interspaces: moderate increase in young connective tissue cells with infiltration by polymorphonuclears in places; vessels: congested, much free blood, eosinophils prominent; periosteum: normal; mucosa: moderate infiltration by connective tissue cells, early fibrosis	Pneumococcus type 4	10 days	6 weeks	Improved
	Left	Antrum: no frank pus; bone slightly necrotic	Bone: moderate rarefaction in places, otherwise normal; interspaces: marked increase in young connective tissue cells with marked infiltration by polymorphonuclears in places; vessels: congested, much free blood, eosinophils prominent; periosteum: normal; mucosa: moderate infiltration by connective tissue cells and fibrosis, marked invasion by polymorphonuclears and red blood cells in many places	No growth			

3 months	Right	Antrum: moderate amount of mucopus and ganulations	Bone: cartilagenous, few areas of early necrosis; interspaces: marked increase in connective tissue cells; periosteum: slightly thickened; mucosa: marked infiltration by connective tissue cells, free blood in places	Streptococcus hemolyticus	4 months	5 months	Improved
	Left	Antrum: moderate amount of mucopus and ganulations	Bone: cartilagenous, with early absorptive changes in places; interspaces: normal, early fibrosis in some; periosteum: slightly thickened; mucosa: marked infiltration by connective tissue cells	Streptococcus hemolyticus			
10 months	Right	Antrum: cortex thick, compact, moderate amount of pus, large amount of pyogenic thickened mucosa and granulations	Bone: moderately advanced to advanced necrotic changes in many places; periosteum: slightly thickened; mucosa: moderate fibrosis with infiltration by young connective tissue cells in places	Streptococcus hemolyticus	17 days	4 months	Improved
	Left	Antrum: cortex thick, compact, moderate amount of pus, large amount of pyogenic thickened mucosa and granulations	Specimens lost	Diphtheroid			
11 months	Right	Antrum: filled with sticky pus and infected granulations, bone soft and necrotic	Bone: normal cartilagenous in places, early generalized necrotic changes and fragmentation; interspaces: filled with free blood; periosteum: extremely thickened; mucosa: marked thickening and infiltration with young connective tissue cells	Diphtheroid	14 days	6 weeks	Improved
	Left	Antrum: filled with sticky pus and infected granulations, bone soft and necrotic	Bone: normal, cartilagenous in places, early generalized necrotic changes and fragmentation; interspaces: marked increase in young connective tissue cells; periosteum: extreme thickening; mucosa: marked thickening and infiltration with young connective tissue cells	Pneumococcus type undetermined			
2½ months	Right	Antrum: filled with stringy mucopus under pressure, lined with thick grayish pyogenic membrane	Bone: cartilagenous with moderate absorption of calcium; interspaces: moderate increase in young connective tissue cells; mucosa: moderate increase in young connective tissue cells, some edema, some concentration of polymorphonuclears around blood spaces; blood spaces: extremely congested	B. coli nonhemolytic staphylococcus, diphtheroid	2 months	2 weeks	Improved
	Left	Antrum: thickened, small amount of stringy mucopus, lined with thickened grayish membrane	Bone: cartilagenous with moderate absorption of calcium; interspaces: normal, some free blood along the edges; mucosa: moderate infiltration by young connective tissue cells and early fibrosis	Nonhemolytic staphylococcus			
8½ months	Right	Antrum: walls rough, contains small amount of stringy secretions not under pressure	Bone: normal cartilagenous except for moderate necrosis in places; interspaces: normal; periosteum: moderately thickened; mucosa: moderate infiltration by connective tissue cells	Diphtheroid	2 weeks	7 weeks	Improved
	Left	Antrum: pus under pressure	Bone: normal cartilagenous except for mild necrosis in places; interspaces: marked increase in young connective tissue cells, in places lamellar cells were becoming surrounded by calcium except at edges of older bone; mucosa: marked infiltration by connective tissue cells and lymphocytic cells	Streptococcus hemolyticus			

TABLE 3.—*Data of Pathologic Changes in Class 3—Continued*

Age	Side	Macroscopic Examination	Microscopic Examination	Bacteriology Cultures lost	Interval Between Onset and Operation 6 weeks	Interval Between Operation and Discharge 3 weeks	Result Not improved
5½ months	Right	Antrum: filled with granulations, little pus, more found in superficial cells	Bone: cartilagenous; interspaces: slight increase in young connective tissue cells; periosteum: slightly thickened; mucosa: moderate invasion of young connective tissue cells, and early fibrosis				
	Left	Antrum: filled with granulations, little pus, more found in superficial cells	Bone: cartilagenous, with early absorption of calcium; interspaces: slight increase in young connective tissue cells; periosteum: slightly thickened; mucosa: slight edema, moderate infiltration by young connective tissue cells, and fibrosis				
9 months	Right	Antrum: free pus....	Bone: cartilagenous with moderate absorption of calcium in places; interspaces: moderate infiltration by young connective tissue cells; periosteum: normal; mucosa: marked infiltration by young connective tissue cells and polymorphonuclears	Staphylococcus hemolyticus and nonhemolytic staphylococcus	5 days	Still in hosptial after six months	Improved
	Left	Antrum: apparently normal	Bone: cartilagenous except for early absorptive changes in places; interspaces: slight increase in young connective tissue cells; periosteum: normal to extremely thickened; mucosa: marked infiltration by connective tissue cells	Nonhemolytic staphylococcus and diphtheroid			
6 weeks	Right	Antrum: extended far forward into root of zygoma, filled with pus under pressure and hyperplastic mucosa	Bone: cartilagenous; interspaces: normal; periosteum: slightly thickened; mucosa: slight increase in young connective tissue cells	B. coli communior	2 weeks	12 days	Improved
	Left	Antrum: filled with thick ropy pus and granulation tissue; periosteum: markedly adherent	Bone: compact, moderate absorption of calcium, fragmentation along edges; interspaces: filled with free blood; periosteum: slightly thickened; mucosa: moderate increase in young connective tissue cells	Subtilis			
7 months	Right	Antrum: thick ropy pus under some pressure	Bone: normal cartilagenous except for occasional areas of advanced necrosis; interspaces: normal, except for some congestion of vessels and some free blood in places; periosteum: moderately thickened; mucosa: some increase in young connective tissue cells	Staphylococcus hemolyticus and nonhemolytic staphylococcus	1 day	10 days	Died
	Left	Antrum: large, ropy pus not under pressure	Bone: advaneed generalized necrosis; interspaces: normal; periosteum: extremely thickened; mucosa: early fibrosis	Staphylococcus hemolyticus and nonhemolytic staphylococcus			
13½ months	Right	Antrum: watery pus under pressure	Bone: normal cartilagenous except for moderate calcium absorption in some places and moderate necrosis in others; interspaces: normal; periosteum: normal; mucosa: some infiltration by young connective tissue cells	Staphylococcus hemolyticus	3 months	6 weeks	Improved
	Left	Antrum: thick mucopus, large amount of infected granulations	Bone: cartilagenous with moderate absorption of calcium in places, nuclei absent in some places; interspaces: normal; periosteum: normal; mucosa: slight infiltration by young connective tissue cells	Staphylococcus hemolyticus			

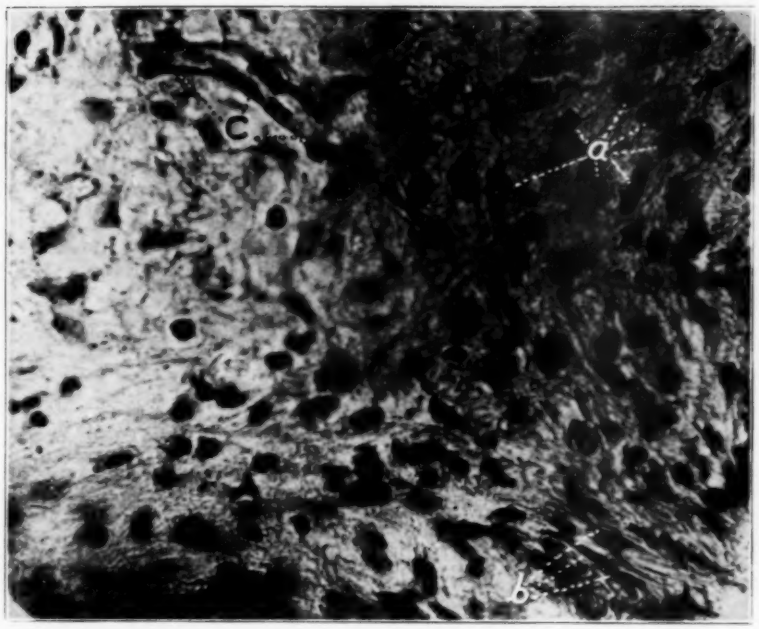

Fig. 2.—Connective tissue cells in edematous mucosa. *a* indicates young connective tissue cells; *b*, older connective tissue cells and *c*, blood capillary. High power magnification.

Fig. 3.—Fibrosis of mucosa and interspaces in classes 3 and 4. *a* indicates fibrous tissue, older connective tissue cells predominating; *b*, blood capillaries, congested; *B*, normal cartilagenous bone; *c*, fragmentation; *d*, periosteum, thickened. Low power magnification.

TABLE 4.—*Data of Pathologic Changes in Class 4*

Age	Side	Macroscopic Examination	Microscopic Examination	Bacteriology	Interval Between Onset and Operation	Interval Between Operation and Discharge	Result
6 weeks	Right	Antrum: pus under pressure	Bone: normal except for occasional areas of rarefaction and fragmentation at edges; interspaces: marked increase in connective tissue cells; periosteum: extremely thickened; mucosa: moderate fibrosis and infiltration with red blood cells	Pneumococcus type 3	12 days	1 month	Improved
	Left	Antrum: pus under pressure	Bone: normal except for signs of early absorption of calcium and areas of fragmentation along edges; interspaces: marked increase in connective tissue cells; periosteum: extremely thickened; mucosa; moderate fibrosis	Hemolytic B. coli			
11 months	Right	Antrum: filled with thick stringy muco-pus	Bone: normal cartilagenous with signs of early absorption of calcium; interspaces: normal; periosteum: slightly thickened; mucosa: moderate infiltration by connective tissue cells and fibrosis	Staphylococcus hemolyticus	9 months	3 weeks	Improved
	Left	Antrum: filled with thick stringy muco-pus	Bone: normal; interspaces: slightly congested; periosteum: slightly thickened, infiltrated with red blood cells in places; mucosa: moderate infiltration by connective tissue cells and fibrosis	No growth			
10½ months	Right	Cortex: thick; antrum: small amount of pus; mucosa: slightly hyperplastic	Specimens lost	Streptococcus hemolyticus	7 weeks	9 weeks	Improved
	Left	Cortex: thick; antrum: small amount of pus; mucosa: slightly hyperplastic	Bone: fragmentation along edges, otherwise normal; interspaces: normal; periosteum: slightly thickened; mucosa: slightly edematous, mild invasion by young connective tissue cells	Streptococcus hemolyticus			
2½ months	Right	Antrum: pus under pressure	Bone: occasional areas of early rarefaction; interspaces: early fibrosis; periosteum: moderately thickened in places; mucosa: moderate fibrosis with marked infiltration by polymorphonuclears, lymphocytes and red blood cells	Bacillus of Morgan, hemolytic	16 days	8 days	Died
	Left	Antrum: pus under pressure	Bone: occasional areas of early rarefaction; interspaces: early fibrosis; periosteum: slightly thickened; mucosa: some embryonal tissue with early invasion by connective tissue cells	Bacillus of Morgan, hemolytic			
6 months	Right	Subperiosteal abscess, fistula into large superficial cell; this connects with antrum which contains pus and granulation tissue	Bone: advanced rarefaction and necrosis; periosteum: extremely thickend; mucosa: extremely thickened and infiltrated with connective tissue cells, fibrosed in places	Streptococcus hemolyticus	5 days	5 weeks	Improved

8 months	Right	Antrum: filled with pus and hyperplastic mucosa	Bone: cartilagenous with moderate fragmentation in places, some infiltration by young connective tissue cells in places; interspaces: normal; periosteum: slightly thickened; mucosa: moderate infiltration by connective tissue cells	Streptococcus hemolyticus	17 days	2 months	Improved
	Left	Antrum: filled with pus and hyperplastic mucosa	Bone: cartilagenous with mild to moderate absorption of calcium; interspaces: normal; periosteum: moderately thickened; mucosa: moderate infiltration by connective tissue cells	Streptococcus hemolyticus			
5 months	Right	Antrum: filled with mucopus and granulations; some destruction of bone	Bone: moderate generalized absorption of calcium, some fragmentation along edges; interspaces: moderate increase in young connective tissue cells; periosteum: slightly thickened; mucosa: slightly edematous, embryonal in type	Streptococcus hemolyticus; diphtheroid	3 weeks	4 weeks	Improved
	Left	Antrum: filled with mucopus and granulations more so than right, also more extensive destruction of bone	Bone: cartilagenous, few areas of early necrosis; interspaces: marked increase in connective tissue cells; periosteum: slightly thickened; mucosa: marked infiltration by connective tissue cells, free blood in places, moderate infiltration by polymorphonuclears	Streptococcus hemolyticus			
8 months	Right	Antrum: no frank pus, thick grayish infected granulations	Bone: cartilagenous with early absorption of calcium in places; interspaces: normal; periosteum: slightly thickened; mucosa: marked infiltration by young connective tissue cells and polymorphonuclears in places	Streptococcus hemolyticus	5 weeks	2 months	Improved
	Left	Antrum: no frank pus, thick grayish infected granulations	Bone: cartilagenous; interspaces: increase in young connective tissue cells; periosteum: slightly thickened; mucosa: infiltration by young connective tissue cells, a few aberrant deposits of free calcium	Streptococcus hemolyticus			
10½ months	Right	Cortex: thick; antrum: filled with thick mucopus and thickened mucosa	Specimens lost				
	Left	Subperiosteal abscess; antrum: frank pus, several large cells along squamopetrosal suture contained pus; infected cells along facial ridge	Bone: marked generalized necrotic changes; interspaces: confluent due to breaking down of bony septums; periosteum: moderately thickened; mucosa: marked infiltration by young connective tissue cells and polymorphonuclears	Staphylococcus hemolyticus; diphtheroid, nonhemolytic	6 weeks	10 days	Improved
9 months	Right	Antrum: pus under pressure, infected granulations; cortex: necrotic	Bone: normal cartilagenous except for early necrotic changes in places; interspaces: normal; periosteum: moderately thickened; mucosa: marked infiltration by young connective tissue cells	Pneumococcus type 4	2+ days	8 weeks	Improved
	Left	Antrum: pus under pressure, infected granulations more so than right; cortex: necrotic	Bone: normal cartilagenous except for early necrotic changes in places; interspaces: marked increase in young connective tissue cells; periosteum: slightly to moderately thickened; mucosa: marked infiltration by young connective tissue cells	Pneumococcus type 4	6 weeks	8 weeks	Improved
8 months	Right	Antrum: pus under pressure; mucosa: extremely hyperplastic and edematous	Bone: cartilagenous except for extreme absorption of calcium in places; interspaces: normal; periosteum: slightly thickened; mucosa: infiltrated with young connective tissue cells and polymorphonuclears in places	Pneumococcus type 4			
	Left	Antrum: pus under pressure; mucosa: extremely hyperplastic and edematous; dura exposed, healthy	Bone: cartilagenous; nuclei: absent from cell spaces; interspaces: normal; periosteum: moderately thickened; mucosa: moderately infiltrated with young connective tissue cells and polymorphonuclears	Cultures lost	1+ day	1 day	Died

HISTOPATHOLOGY

In the mucosa that was considered edematous there may have been a small amount of early fibrosis, probably an attempt to overcome the infectious process; likewise, some of the fibrotic specimens showed a few areas of edema. However, the edema unquestionably predominated in the former, as did the fibrosis in the latter.

True necrosis of the bone occurred infrequently. In certain specimens there was a marginal fragmentation and disintegration of the substance of the bone in which the bone showed a ragged edge, thinned by

Fig. 4.—Normal cartilagenous bone. *a* indicates cartilage cells shrunken and stellate; some have dropped out of spaces; *b*, young bone cells. High power magnification.

absorption of calcium, but there was no evidence of a frank mass necrosis or osteoclastic activity as I have seen in bone removed from diseased sinuses.[3]

BACTERIOLOGY

A large number of strains of the usual bacteria, such as are encountered in all acute infections, were present. No particular organism was associated with any particular type of pathologic change. Similar

3. McMahon, B. J.: Pathology of Spheno-Ethmoidal Sinusitis, Arch. Otolargyng. **4**:310 (Oct.) 1926.

organisms occurred in the mastoids of the patients who died and of the patients who recovered, and in about the same proportion. One may conclude, therefore, that the reactions of the tissues immediately involved and of the bodily organism were not in response to a specific infection, but to infection in general (tables 1, 2, 3 and 4).

AGE

Similar pathologic manifestations were found in infants aged from 1 month to 23½ months. Thirty-six of the thirty-nine patients (92.3 per cent) were under 1 year of age. None of those over 1 year died; otherwise, there was no uniformity between the ages of those who died or of those who recovered.

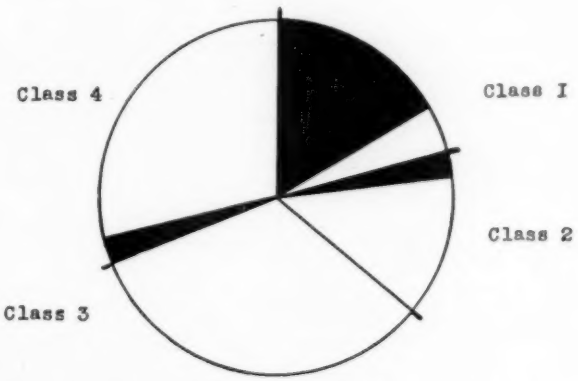

Fig. 5.—Mortality and recovery according to classes. The black areas indicate the mortality and the white areas, recovery.

SUMMARY

In such a small series of cases, it would be premature to draw any but tentative conclusions, subject to subsequent revision or confirmation as further data are accumulated.

The fact that the edema of the mucosa of the mastoid antrums and cells found microscopically, when associated with the syndrome of increased temperature, diarrhea, vomiting, loss of weight and athrepsia, offers a bad prognosis, as evidenced by the deaths of six of eight patients, is significant (table 5).

This fact raises the question as to the cause of the phenomenon: whether it lies in a hyperactivity or a blockage of the neighboring lymphatics or in an increased permeability of the smaller blood vessels as evidenced by the presence of large numbers of free red blood cells and polymorphonuclear leukocytes. The latter explanation implies a more rapid ingress into the circulation of the toxins that are being

elaborated in the mucosa, or the penetration into the circulation of the bacteria themselves, thus giving rise to a fatal septicemia. The solution lies in the realm of physiology and offers an interesting problem for further research.

I feel that another factor was the failure of the adjacent tissues to elaborate sufficiently large numbers of connective tissue cells in response to the local infection. These cells appeared to be largely instrumental in delimiting the infectious process, as exemplified in the mucosal pictures in the cases in class 3, in which no deaths occurred.

For practical purposes, these observations seem to offer the opportunity of a more accurate early prognosis of the outcome of certain types of cases by a microscopic examination of the mucosa immediately after its removal from the infected antrum of the mastoid.

TABLE 5.—*Data of Mortality and Recovery According to Clinical Symptoms*

	Cases		Died		Recovered	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Classes 1 and 3	22	56.4	6	27.3	16	72.7
Classes 2 and 4	17	43.6	3	17.6	14	82.4
	39	100.0	9	23.1	30	76.9

TABLE 6.—*Data of Mortality and Recovery According to Microscopic Pictures*

	Cases		Died		Recovered	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Classes 1 and 2	14	35.9	7	50	7	50
Classes 3 and 4	25	64.1	2	13.3	23	86.7

Though the microscopic pictures in class 2 are practically the same as those in class 1, the absence of a severe systemic reaction in the former offers a much better prognosis. In classes 3 and 4, respectively, in which the fibrosis of the mucosa was so prominent, the prognosis is equally good despite the severe systemic reaction in class 3. Neither the bacteria found in the infected mastoid nor the age of the patient had any influence on the pathologic changes shown microscopically or on the outcome, even though 93.2 per cent of the patients were under 1 year of age (table 6).

It would seem plausible to assume, therefore, that the reason for the deaths and the recoveries from the point of view of the pathologic changes encountered is that while pus and diseased mucosa were removed in all cases, a nonresistant, highly permeable mucosa was left in the cavity of the middle ear in the former, while a resistant mucosa of low permeability was left in the cavity of the middle ear in the latter.

CONCLUSIONS

1. In a series of thirty-nine cases of mastoiditis in infants occurring at the St. Louis Children's Hospital from September, 1926, to May, 1927, twenty-two (56.4 per cent) showed the symptom complex of increased temperature, diarrhea, vomiting, loss of weight and athrepsia.

2. The prognosis is bad if, when edema of the mucosa of the mastoid antrums is found microscopically, the "diarrhea-vomiting symptom complex" is present.

3. The prognosis is good when fibrosis of the mucosa of the mastoid antrums is found microscopically, even though the "diarrhea-vomiting complex" is present.

4. When the "diarrhea-vomiting complex" is not present, the prognosis is equally good whether the mucosa of the mastoid antrums shows edema or fibrosis microscopically.

634 North Grand Boulevard.

GENERAL SEPSIS OF OTITIC ORIGIN

TREATMENT BY BLOOD TRANSFUSION AND GERMICIDAL DYE *

HAROLD I. LILLIE, M.D.
ROCHESTER, MINN.

Blood transfusion has been suggested as a valuable supportive therapeutic measure when used in conjunction with well directed surgical intervention in certain cases of general sepsis secondary to suppurative disease of the temporal bone. More recently, the intravenous injection of dye germicides was suggested because of good results obtained in certain cases. The idea of the combined use of blood transfusion and germicidal dye seems particularly practical, especially if all that is claimed for both methods is true and if the citrate method of blood transfusion is used. The results with this method so far are satisfactory but no more striking than the results with blood transfusion alone.

Blood transfusion is not a new therapeutic measure, although certain refinements in the method of usage have eliminated most of the danger inherent in its application. General sepsis as the result of aural suppuration was not recognized until long after abscess of the brain and meningitis of otitic origin were known. Abercrombie, in 1816, described rather accurately a case encountered at necropsy. Zaufal, in 1880, recommended tying the internal jugular vein and opening the sinus. Lane, an English surgeon, in 1888, was the first to operate successfully in such a case. The following year Ballance, the English aural surgeon, reported four cases.

Feinblatt [1] said that the earliest records of blood transfusion were vague and contradictory, probably because the drinking of human blood was practiced during medieval times for the purpose of restoring health, and he argued that it is difficult to understand how transfusion could be employed without knowledge of the circulation of the blood.

It is said that a Jewish physician gave Pope Innocent VIII a blood transfusion in 1492. With Harvey's announcement of his theory of circulation of the blood, new interest was aroused in blood transfusion.

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* From the Section on Otolaryngology, Mayo Clinic.

* Read before the Minnesota Academy of Ophthalmology and Otolaryngology, St. Paul, Minnesota, April 8, 1927, and the Detroit Eye, Ear, Nose and Throat Society, Detroit, Michigan, April 20, 1927.

1. Feinblatt, H. M.: Transfusion of Blood, New York, The Macmillan Company, 1926, p. 137.

Three serious obstacles stood in the way of successful transfusion: (1) coagulation of the blood, (2) infection and (3) hemagglutination of incompatible bloods. The first transfusion to be successful in the lower animals was performed in 1665 by Lower.

The first authenticated blood transfusion in man was performed by Denys, physician to Louis XIV, in 1667. He injected lamb's blood into an exsanguinated patient. Later transfusion was forbidden, because many deaths had resulted from its use.

It was not until 1900 that Lansteiner and Shattock, working independently, demonstrated the presence of iso-agglutinating and iso-agglutinable substances in human blood, and thus explained the severe and sometimes fatal reaction from transfusion.

Jansky, in 1907, showed that all human blood falls within four groups. Moss, in 1910, confirmed Jansky's observations, and noted further "that isohemolysis of the red blood cells never occurs without their previous agglutination, although iso-agglutination may take place independently of isohemolysis." The Jansky classification is recognized by the American Medical Association.

Crile popularized blood transfusion by his description, in 1907, of a practical direct method. Since then paraffin-coated containers, multiple syringes, citrate anticoagulation and syringe and stopcock methods have been used successfully and satisfactorily.

Each method has its advocates. Unger [2] has suggested that the addition of sodium citrate to blood that is transfused may give rise to deleterious effects. He concluded that the red cells were made more fragile, the available quantity of complement was diminished, the opsonic index was reduced, and the phagocytic powers of the white cells were practically destroyed. Mellon, Hastings and Cosey [3] were unable to confirm Unger's observations. It apparently matters little which method is used, the choice depending largely on the facilities at hand. The citrate method is used at the Mayo Clinic.

Feinblatt says that the transfusion of blood benefits the recipient in three chief ways: (1) by filling the vessels with a viscous medium, (2) by adding a considerable number of oxygen carriers and (3) by furnishing a powerful hematopoietic stimulus. It is highly probable that transfusion is beneficial in other ways, but the mechanism by which it confers benefit has not, as yet, been satisfactorily explained.

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2. Unger, L. J.: The Deleterious Effect of Sodium Citrate Employed in Blood Transfusion, J. A. M. A. **77**:2107 (Dec. 31) 1921.

3. Mellon, R. R.; Hastings, W. S., and Casey, G. U.: Observations on the Effect of Sodium Citrate on the Blood Especially Considering the p_H Factor, J. A. M. A. **79**:1678 (Nov. 11) 1922.

It is known, however, that with the correct grouping of the donor's and recipient's bloods, the donor's cells may be demonstrated in the recipient's blood after long periods of time.[4] It is obvious that transfused blood would supply the body's own weapons for combating infection, and might be sufficient in amount to tide the patient over the critical period. Occasionally the effect of transfusion appears to be specific and striking, but at other times it is less striking or apparent.

The blood grouping of donor and recipient are extremely important, and unless one cares to make a careful study of the subject, this should be left to the expert hematologist and not to house officers or inexperienced men. The blood of members of the same family does not necessarily fall into the correct groups, and it is extremely important that this fact be known. It would appear that the transfusion of blood from a purposely immunized donor would be particularly effective, but this has not been borne out clinically.

If good results were obtained from the use of transfused blood, it seemed that, because of the good results reported by Young[5] and others from the use of germicidal dye alone, the addition of germicidal dye to the blood transfused should produce still better results. For many years the intravenous injection of drugs intended to destroy or injure the cause of the disease had been practiced with varying degrees of success. It was only natural that some investigator would look for an antiseptic to be used intravenously that would possess a high degree of germicidal power with a comparatively nonirritating effect. To White and his co-workers belongs the credit for the introduction of mercurochrome-220 soluble.

Young reported 78.6 per cent of cures as a result of the intravenous use of mercurochrome in cases of sepsis due to infection in the ear and lateral sinuses. More recently, Porter[6] suggested certain refinements in the use of this drug. He believes that there was a certain time in the temperature curve cycle when mercurochrome was most effective, and that smaller doses, or at least weaker solutions, are used to better advantage in certain of the more serious cases.

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4. Ashby, Winifred: The Present Status of the Question of the Length of Life of the Unagglutinable Transfused Red Blood Corpuscle, Arch. Int. Med. **34**:481 (Oct.) 1924. Wearn, J. T.; Warren, Sylvia, and Ames, Olivia: The Length of Life of Transfused Erythrocytes in Patients with Primary and Secondary Anemia, Arch. Int. Med. **29**:527 (April) 1922.

5. Young, H. H.: The Sterilization of Local and General Infections: Experimental and Clinical Evidence of Results Obtained by Intravenous Injection of Mercurochrome-220 Soluble, J. A. M. A. **87**:1366 (Oct. 23) 1926.

6. Porter, C. T.: The Intravenous use of Mercurochrome in Septicemias, Tr. Am. Otol. Rhin. & Laryn. Soc., 1926, p. 93.

Mercurochrome is said to be uniformly germicidal and is especially effective against *Bacillus coli.* Gentian violet is claimed to be specific for gram-positive cocci, especially staphylococci, but it is more difficult to prepare and standardize than mercurochrome.

If the blood culture is positive and the organism is identified, the addition of the germicidal dye, the choice depending on the organism, in the correct dosage (5 mg. for each kilogram of body weight) to the blood to be transfused should be more effective than transfusion or the use of dye alone, if all that is claimed for both is true. Blood transfusion is looked on as a supportive therapeutic measure and the use of germicidal dye as a curative therapeutic measure.

Hays,[7] Babbitt,[8] Unger[9] and Phillips[10] have reported success with the use of blood transfusion in general sepsis secondary to otitic disease.

INDICATIONS FOR TRANSFUSION

Blood transfusion is not necessarily indicated in all cases of sepsis of otitic origin. One would hesitate to subject a patient to the added danger of transfusion, even though the possibility of an untoward result might be remote, when the clinical course and physical condition following well directed surgical management give every indication of being satisfactory. There are patients whose physical appearance, however, indicates that unless heroic measures can be used, the illness will overcome the bodily resistance and death will ensue.

Experience has shown that transfusion may be useful preoperatively. Patients in serious physical condition as the result of sepsis of comparative long standing withstand operation much better if given transfusion preoperatively. Occasionally the result is so striking that one might have a tendency to withhold operation. It must be borne in mind, however, that the original focus of infection must be removed; in other words, blood transfusion or intravenous injection of germicidal dye is not employed to supplant well directed surgical intervention.

Postoperatively, transfusion is useful in cases in which the clinical course is not satisfactory, as manifested by a persistent septic type of

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7. Hays, Harold: Blood Transfusion in Otological Diseases, Laryngoscope **33**:253, 1923; The Value of Blood Transfusions in Postoperative Mastoid Conditions, with Special Reference to Suspected Sinus Thrombosis, New York State J. Med. **26**:10, 1926.

8. Babbitt, J. A.: Lateral Sinus Thrombosis Presenting Unusual Variation; Streptococcemia, Transfusion, Recovery, Ann. Otol. Rhinol. & Laryngol. **34**:505, 1925-1926.

9. Unger, L. J.: Blood Transfusion for Otological Diseases, Laryngoscope **33**:250, 1923.

10. Phillips, W. C.: The Diagnosis and Treatment of Septic Sinus Thrombosis, J. A. M. A. **81**:633 (Aug. 26) 1923.

temperature, by increasing anemia, due to loss of blood at operation or to the effect of the disease, or by lowering bodily resistance to the point where the "comeback" may be long delayed if left to natural reparative processes. Transfusion in such instances may produce a striking effect or improvement in the physical condition without such an apparent effect. It may have to be repeated to obtain the maximal benefit.

The general beneficial effect is manifested by the increased alertness and interest of the patient in himself and in his surroundings, the apparent increase in hemoglobin, as indicated by return of color to the lips and cheeks, sparkle to the eyes, and improvement in appetite and more restful sleep. If the patient's recovery is left to natural reparative processes, the result may be the same, but the course without transfusion in such cases has been much more protracted.

By way of digression, it might be said that forced feeding, even when the temperature was high, has proved to be of great therapeutic value in all cases of sepsis of otitic origin in my experience. The reasons would seem obvious, although the tendency in febrile cases is not to insist on feeding.

MATERIAL STUDIED

Blood transfusion or blood transfusion combined with the injection of germicidal dye was used fourteen times in twelve cases in conjunction with whatever major operation seemed indicated. The internal jugular vein was ligated in ten cases. The clinical course in the other two, following removal of the primary focus and uncovering of the area of phlebitis of the sigmoid sinus, was so satisfactory that ligation of the internal jugular vein was not required.

This group comprised 40 per cent of the patients with sepsis of otitic origin. In the 60 per cent in which transfusion was not necessary, there were two deaths; both patients were in extremis when they were seen. One patient in the former group died, an aged man who was also in extremis as he had not sufficiently recovered from recent erysipelas when the transfusion was given.

Transfusion alone or transfusion combined with the intravenous injection of germicidal dye has been used in several ways, and the cases are grouped according to the stage of the illness at which one of these measures was employed.

REPORT OF CASES

Postoperative Use of Blood Transfusion.—Blood transfusion was first used at the Mayo Clinic for sepsis of otitic origin in 1918, in a case in which the condition was not sufficiently improved following operative intervention and in which the blood culture continued to show *Streptococcus viridans.* The result was so definite that it would seem that the supportive effect of the transfusion had been

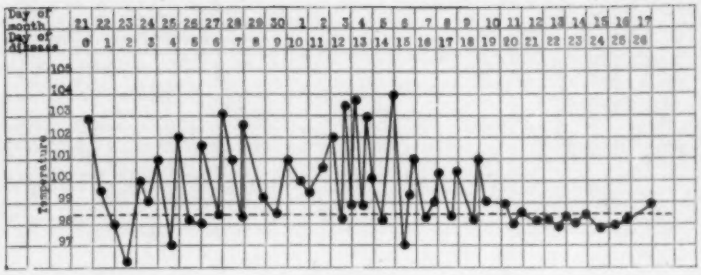

Fig. 1.—Temperature chart following postoperative blood transfusion.

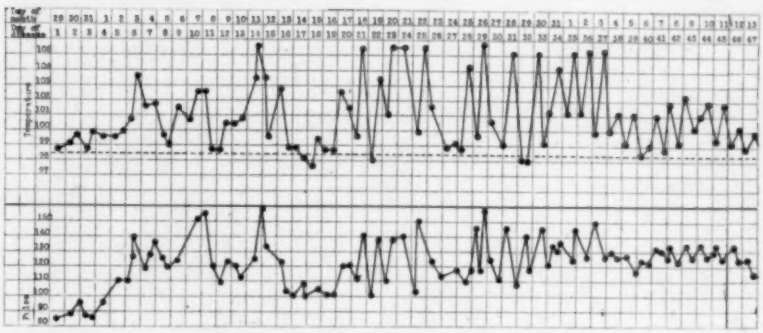

Fig. 2.—Pulse and temperature chart following postoperative blood transfusion.

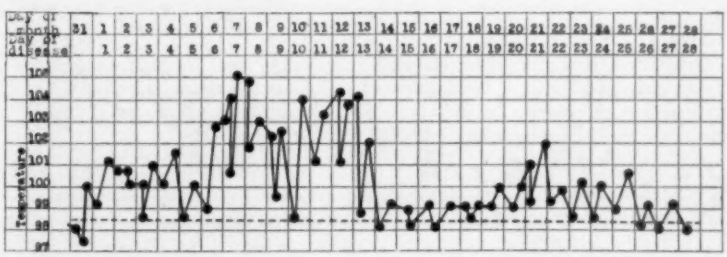

Fig. 3.—Temperature chart following preoperative blood transfusion.

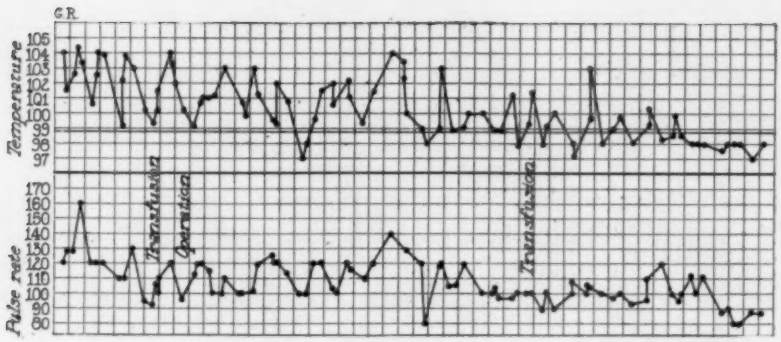

Figure 4

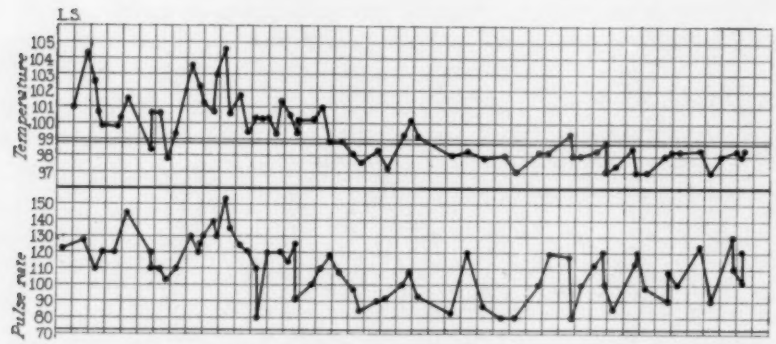

Figure 5

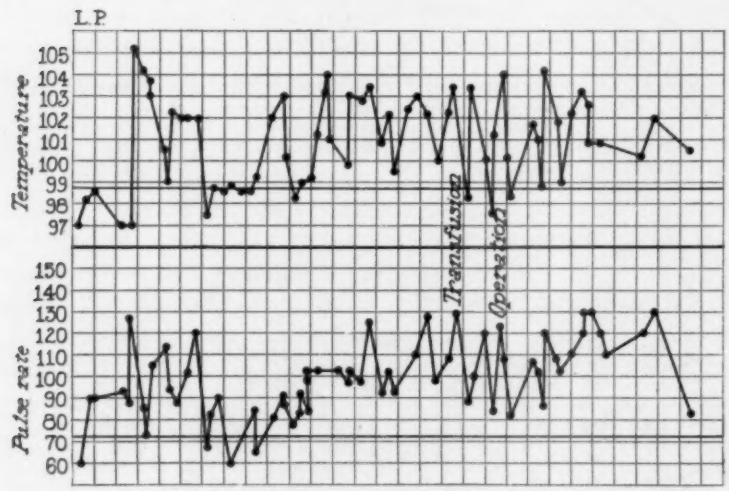

Figure 6

Figs. 4, 5 and 6.—Pulse and temperature charts following preoperative blood transfusion.

enhanced by the natural immunity of the donor. In another case, the effect was striking (fig. 1). In still another case, however, in which spontaneous hemorrhage from the sigmoid sinus had taken place, transfusion was given twice without apparent benefit so far as the clinical course was concerned (fig. 2). Much improvement seemed to result from the intravenous injection of serum. Blood cultures were repeatedly negative in this case.

Transfusion Before Operative Intervention.—Transfusion was tried from six to twenty-four hours before operation in four cases, as it seemed to be a rational procedure. All of the patients appeared to be in an extremely serious condition. The infecting organism proved to be the hemolytic streptococcus. In three instances, the patients withstood operation well and did not manifest any serious surgical shock (figs. 3, 4 and 5). The fourth, an old man, partially recovered from erysipelas, who developed a sinus thrombosis, did not react so favorably to

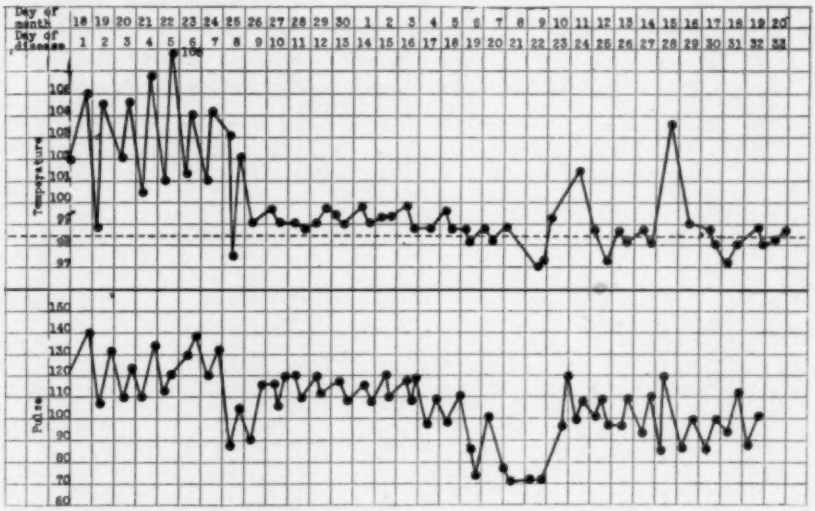

Fig. 7.—Pulse and temperature chart following blood transfusion during operation.

blood transfusion or operation, and died (fig. 6). In one case transfusion was also used during the postoperative course, with definite clinical and physical improvement.

Transfusion at Time of Ligation of Internal Jugular Vein.—The patient who received a blood transfusion at the time of ligation of the internal jugular vein was so seriously ill that the internist suggested that operation be postponed. Blood culture showed a virulent hemolytic streptococcus. The physical examination revealed a secondary focus in the chest (pleurisy with effusion) and an abscess over one ankle, the site of an old attack of osteomyelitis. Operation revealed the source of the sepsis to be phlebitis of the lateral sinus. The outcome was gratifying (fig. 7).

Preoperative Use of Blood Transfusion Combined with Injection of a Germicidal Dye.—The first patient in whom this method was used was not extremely sick, but the blood culture showed pneumococcus, type III. A 0.25 per cent solution of gentian violet, 5 mg. for each kilogram of body weight, was used in conjunction

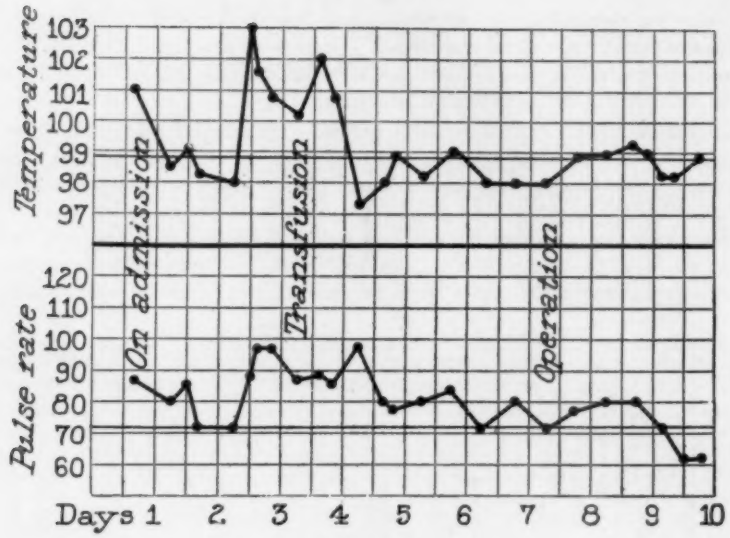

Figure 8

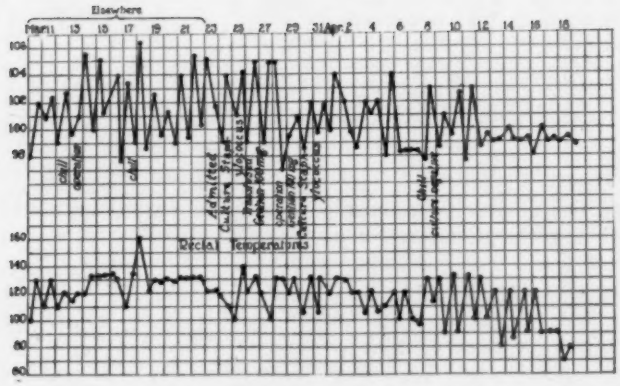

Figure 9

Figs. 8 and 9.—Pulse and temperature charts following preoperative blood transfusion combined with injection of germicidal dye.

with 250 cc. of blood transfused by the citrate method, although no doubt it could have been used alone. Within six hours, the septic temperature had become normal, and remained so. Operation revealed a so-called hemorrhagic type of mastoiditis with a large area of phlebitis, although the sinus plate seemed normal. The sinus and vein were not disturbed.

The condition of the other patient in this group required considerable study, as both mastoids had recently been operated on. The wounds appeared to be in good condition. The blood culture showed staphylococcus, and the bedside chart brought with him indicated that the temperature had been septic for more than two weeks. Both jugular veins had been ligated successfully, but in this case an

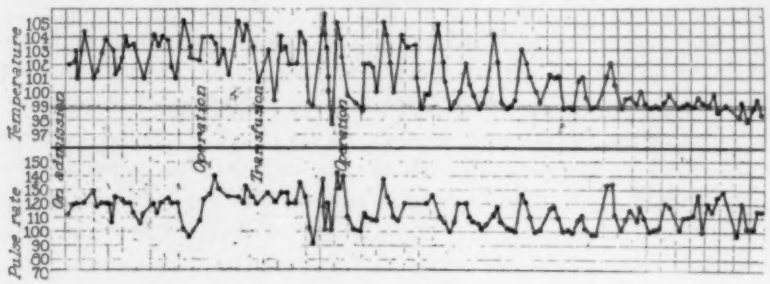

Figure 10

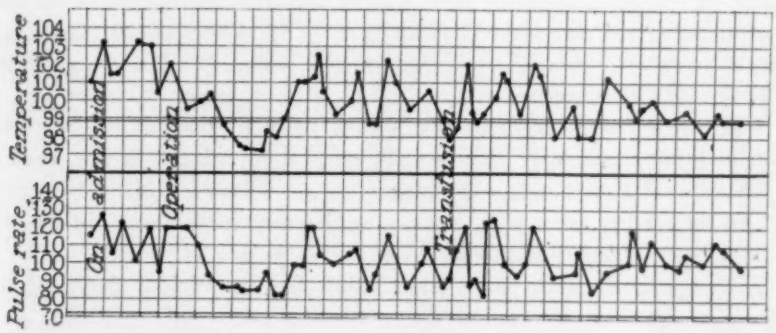

Figure 11

Figs. 10 and 11.—Pulse and temperature charts following postoperative blood transfusion combined with injection of germicidal dye.

effort was made to determine the side which was the source of the trouble. The Tobey-Ayre test was unknown at that time. As it was seen that a delay of a few days would not affect the course, it was decided to use 0.25 per cent gentian violet with transfusion before operation. Sinus thrombosis was encountered on the left side and was taken care of in the usual way. The result was satisfactory. As the patient's condition improved, he was no longer rebellious but cooperative (figs. 8 and 9).

Postoperative Use of Transfusion Combined with Injection of Germicidal Dye.—This method was used in two cases, in one of which the blood culture was repeatedly negative. Mercurochrome was the germicidal dye employed. Why

blood transfusion alone was not used is not readily understood; possibly the patient was not improving, and therefore every agent of any value was tried in an attempt to combat the disease. The other patient in this group responded well. The organism found was the pneumococcus, type III, and gentian violet was used to attack it. The temperature dropped to the normal range, and the blood culture became negative (figs. 10 and 11).

Repeated Transfusion as a Supportive Measure.—In two cases more than one transfusion was used. In the patient of the first group little benefit was noted, but the patient in the third group was definitely improved by the second transfusion, which was used postoperatively.

SUMMARY

From the study of so small a group of cases (twelve), it is difficult to evaluate accurately the beneficial effect of blood transfusion or of blood transfusion combined with intravenous injection of a germicidal dye. The effect on the temperature seems graphic enough, and the general effect on the patient's condition is also definite but not readily put into words. I am not prepared to say whether the combined method or blood transfusion alone is preferable, as the patients in whom blood transfusion alone was used seemed to do as well as the others.

I wish particularly to emphasize the fact that more reliance may be placed on well directed surgical intervention than on either blood transfusion or the combined method, but as adjunct therapeutic measures great benefit may be derived from them. In other words, from our present knowledge it can be said that surgical treatment is not supplanted by either of these methods.

Untoward results have been reported from the use of the methods described, but the danger may be reduced to the minimum if the services of an expert hematologist or biochemist are always utilized. Interns and house officers, as a rule, are not sufficiently experienced in the use of these specialized therapeutic measures.

My experience with blood transfusion and germicidal dye, and the reports of others, convince me that their use as an adjunct therapeutic measure is rational if the cases are properly chosen and the agents properly prepared and administered. The supportive effect of blood transfusion is to shorten convalescence; the germicidal dye is a curative measure. I am not defending or advocating the use of the measure; I am merely reporting my impressions from observation of its use. I feel that the measure has its place in the management of sepsis of otitic origin.

AN UNUSUAL TYPE OF DIPLACUSIS*

DOUGLAS MACFARLAN, M.D.
PHILADELPHIA

The diplacusis described in this paper was my own case and presented an unusual opportunity for study.

During an acute attack of purulent rhinitis of the ordinary "head cold" variety, bilateral eustachian catarrh, stuffiness in the ears, impaired hearing, a "sea-shell" tinnitus, transitory spells of dizziness and diplacusis developed. The dulness of hearing, diplacusis and tinnitus were

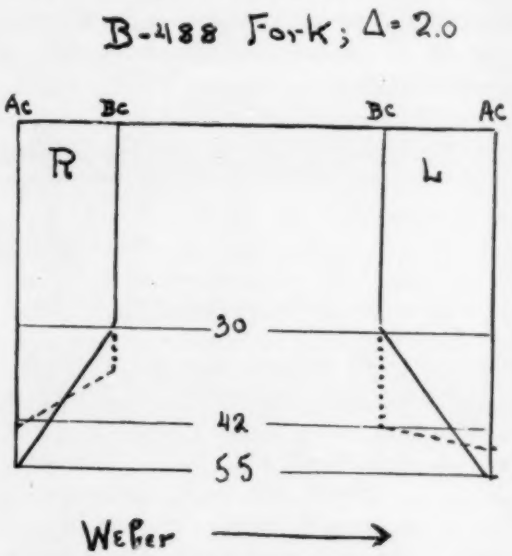

Fig. 1.—B 488 Koenig fork (which was interpreted as D 581 in the left ear by reason of false impression). The fork was struck a standard blow by a swing pleximeter, and was timed by a stop watch from the time struck. The normal for this fork is thirty seconds bone conduction, and fifty-five seconds air conduction. The dampening factor expressed in sensation units per second is 2.0, the factor K for reducing the loss of hearing to percentage is 0.81 (1).

constant for two periods, lasting from three to four days each; a remission of symptoms lasted for a week between the two attacks. There had not been any previous trouble with the ears.

As all the symptoms in the ears appeared simultaneously, the diplacusis was immediately manifested. The false note was heard only in the left ear, and took the pitch of the second semitone above the true tone. The left ear was somewhat more deafened than the right ear. The tests

* From the Graduate School of Medicine of the University of Pennsylvania.

of hearing showed symptoms of the acute incipient catarrhal type—bone conduction lengthened above normal in each ear and air conduction proportionately decreased. The Weber test referred to the worst ear and a high plus-minus Rinne test in the left ear and a high plus Rinne test in the right (fig. 1).[1]

The peculiar feature of the case is that the type of the diplacusis, instead of being a quarter or a semitone above the true tone as in the majority of cases cited by others, was two semitones above. Thus, when single tones were listened to, the perfect harmonic complement was heard in the left ear. The effect was one of a duet: music that I whistled or sung gave the same effect that was noticed in listening to others. The range of this false impression existed only between the pitches F-345 and E-651; the hearing above and below these pitches was true.

The false note in all instances was complementary, taking the ratio 1:4 in the logarithmic scale.

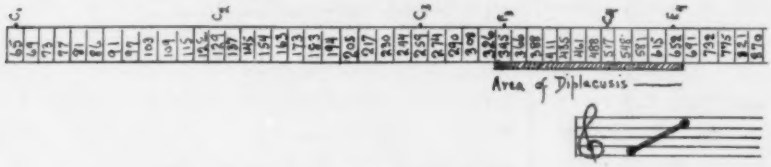

Fig. 2.—The equally tempered scale, A 435.

The logarithmic scale of frequencies is one in which the spaces are proportional to the ratio of the frequencies; it is represented in actual sounds by the successive tones of the pianoforte. For instance, the successive octave points represent tones having frequencies in the ratio 1:2:4:8:16, etc.; the ratio is the same throughout, and the actual distance in inches from any note to its octave on the scale, and also on the piano keyboard, is the same, whether the note is on the lower part of the scale where the number of vibrations is small, or whether it is on the upper part of the scale having several thousand vibrations per second—hence the distance between any two specified partial tones is constant throughout the logarithmic scale[2] (fig. 2).

All symptoms cleared up spontaneously within two weeks, coincident with the disappearance of the "head cold."

COMMENT

Shambaugh and Knudsen report ten cases of diplacusis, seven of which showed the false hearing above and three below, the correct tone. In six cases the effect extended over the entire tonal range, from 50 to

1. Fletcher: New Methods and Apparatus for Testing the Acuity of Hearing, Laryngoscope **35**:501 (July) 1925.

2. Miller, Dayton C.: The Science of Musical Sounds, New York, The Macmillan Co., 1922.

4,800 double vibrations. The most conspicuous characteristic is that in all of the cases there was a positive diagnosis of disease of the internal ear. In not a single case was there any evidence of a disease of the middle ear that could be held responsible for this symptom. The conclusion is that diplacusis is characteristic of disease of the internal ear.

It appears that the case here cited showed some congestion of the inner ear which was responsible for the diplacusis and dizziness. The picture, however, was one of an acute aural catarrh of a transitory nature. There were symptoms of disease of the inner ear as well as of the middle ear. For the most part, Shambaugh's cases showed differences in pitch of quarter and semitones. There is no mention in his reports or in other investigations of such exact harmonic relations.[3]

Shambaugh's [4] reasoning in his cases is so logical that it merits repetition. "To the physiologist the problem of particular interest has to do with the type of pathological changes in the cochlea that are responsible for this interesting symptom, and the conclusions that may be drawn from its occurrence regarding the theory of sound perception. One thing is apparent, the ordinary degenerative changes from whatever source do not cause this symptom, since it is only the exceptional case of internal ear disease where it occurs." Assuming the rationality of his theory that the tectorial membrane is the responsive mechanism in transformation of sound, Shambaugh says: "It would seem from its sudden onset that the symptom of diplacusis is probably due to some pathological deposit adhering to the tectorial membrane, for example: a blood clot or a fibrinous deposit; such a deposit would influence its vibrating qualities so that a segment that normally vibrates to a certain tone will now vibrate to a tone just below or just above this tone.

It would seem that the transitory character of the diplacusis in the case reported might readily be explained on such lines, yet the exactness of the harmonic relations exhibited over nearly an octave would require an exactness of deposit of a fibrinous deposit such as is improbable. The limits of demarcation of the diplacusis reported were sharp, and just beyond these limits the tones were again true. The exact pathologic condition is still conjectural.

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3. If overtones have frequencies that are exact multiples of that of the fundamental, they are called harmonics; otherwise, they may be designated as inharmonic partials (Miller). In my case, the false note was invariably two semitones above.

4. Shambaugh, G. E.: Labyrinthine Deafness with Diplacusis, S. Clinics, Chicago **4**:695 (Aug.) 1920.

PULSION DIVERTICULUM COMBINED WITH MEGA-ESOPHAGUS *

LOUIS VAN DEN WILDENBERG, M.D.
Professor of Otolaryngology, University of Louvain
LOUVAIN, BELGIUM

There are few countries in which the question of esophageal diverticulum has been the object of so much and such important scientific study as in the United States. In this country one finds writers who have seen and treated more than 100 patients.

Not long ago this condition was considered rare. In 1911, Starck said that his statistics of 93 cases, reported in 1900, and including all the cases known in the literature, had increased by 57 cases, making 150 in all. He concluded that a better knowledge of the disease and an improvement in the methods of examination had made a relatively frequent malady out of a condition that had been thought rare. Many writers use that phrase when they publish a classic case of diverticulum. The publication of classic cases becomes rarer and rarer, but the literature does not become less interesting, because unconsciously it has passed on to the description of rare forms of diverticulum which presumably throw more light on the thus far obscure pathogenesis and etiology of the condition.

Starck's statistics of 1911 call attention to the fact that the first symptoms indicating a pulsion diverticulum do not manifest themselves in patients under 30 years of age. The important work of Chevalier Jackson and Shallow mentions the first known case of congenital esophageal diverticulum in a child, 6 years of age. A photomicrograph of a cross-section illustrates this important observation. The same authors later mention a case of juvenile diverticulum; the patient had definite manifestations of this condition at the age of 15 years.

In this remarkable contribution there also appears the masterful, clear-cut description, with illustrative roentgenograms, of a case of double pulsion diverticulum. There were two diverticular sacs, one to the left and one to the right. Esophagoscopy showed that there were two sacs with distinct orifices. I have found nothing similar in the rich literature of diverticulum. Hill and Guisez each mention a case of pulsion diverticulum of the thoracic esophagus at the level of the left bronchus.

Vinson observed four cases of epiphrenic diverticulum not far above the diaphragmatic level. These epiphrenic pulsion diverticula are rare. They cause distressing symptoms, unlike traction diverticula, which do

* Read at the Annual Meeting of the American Laryngological Association, Atlantic City, May, 1927.

not as a rule cause any discomfort. Since 1918 I have observed twenty-five cases of pulsion diverticulum, and of these, one was a case of the epiphrenic type.

REPORT OF CASES

CASE 1.—*History.*—A woman, aged 32, of fairly good general appearance but thin, presented herself for examination on June 2, 1920. When she was 21, a child was born who died at the age of 1 year. Unilateral ovarectomy had been performed when she was 23. The menses were normal. The first symptoms of which the patient complained appeared about one year previously; she attributed them to troubles and worries at that time. Since then, the patient had had a sensation of food stopping at the lower end of the esophagus, the location of which she accurately indicated; she said that she was obliged to wait before taking another mouthful, until that which preceded had gone down into the stomach; her meal was thus greatly prolonged. This difficulty in swallowing occurred with liquids as well as with solids, but it seemed more marked with the latter. The condition was not continual; there were periods of improvement alternate with periods of difficulty; the latter was brought on or aggravated by nervous exhaustion and fatigue. The patient considered herself at the time of presentation, in a period of remission which had lasted about two weeks.

Roentgen-Ray Examination.—The capsule went down normally to the cardia; it remained at this point and was still visible, partially disintegrated, thirty minutes after ingestion.

The opaque liquid, ingested about ten minutes after the capsule, normally penetrated to the cardia; at this moment a part of the liquid was seen to form a rounded shadow a full centimeter in diameter, 3 cm. from the cardia, regular and dense in its lower part, vague in the upper; this shadow was located in front and to the left of the column of opaque liquid contained in the normal lumen of the esophagus; it was separated from that by a groove which could partially be brought in evidence in the right anterior oblique position. This was obviously a case of a diverticulum of the lower portion of the esophagus.

The passage of the opaque liquid through the cardia required about ten minutes; it took place intermittently in spurts, the cardia opening rapidly, letting a little of the liquid through, then closing suddenly. The contours of the column of opaque liquid at the level of the cardia were regular, without lacunae or notches.

A diagnosis of "cardiospasm" was made, with a diverticulum a little above the diaphragm. In order to confirm this diagnosis the patient was to be examined again in eight days and she was to take antispasmodics of the belladonna series in the meantime.

She did not return and nothing was heard of her until Jan. 15, 1925. The condition had slowly become worse, with periods of remission, since 1921.

In the periods of difficulty both liquid and solid foods were stopped at the cardia and returned at once; the patient indicated clearly the location of the cardia as the site of her discomfort; these periods lasted for three or four days as a rule, during which everything she ate was vomited; as at the beginning, the periods were more intense when she was suffering from worry and fatigue. In addition to these periods of vomiting, cold liquid and pieces of meat were always returned at once, even during the periods of remission; meat could pass only when finely chopped. The patient tested her cardia at the beginning of a meal by taking warm or hot liquid; if that passed, there were chances that the other food would do likewise.

There was often nocturnal regurgitation of a small quantity of the food swallowed in the evening; at the present time these regurgitations are frequent, but less abundant; they occur most frequently in the morning when the stomach is empty.

The various medicinal treatments did not help and brought only temporary improvement. Only copious gastric lavage (2 liters of bicarbonate solution), performed for three months at the beginning of 1924, procured a slightly longer improvement; at that time the patient could eat almost everything, except roast beef. Since the beginning of her illness she had lost about 21 Kg. in weight; but she regained 4 Kg. in one year.

Roentgen-Ray Examination.—The opaque liquid went down at once to the cardia through the dilated esophagus, the average diameter of which was about 4 cm. in the lower third, which contained a little liquid although the patient was fasting.

An opaque shadow was seen near the cardia, to the left and in front of the esophagus, and was larger than at the time of the previous examination. It was about 2 cm. in diameter and the lowest part was a full centimeter above the cardia.

The shadow of a diverticulum partially filled with opaque liquid was rounded except for the part which was in contact with the esophagus, which was rather flat; the upper part followed the line of the fluid level.

The diverticulum contained some of the opaque liquid in its lower and larger part; above this was a layer of from 3 to 4 mm. of nonopaque liquid, a residue which was already in the diverticulum and which floated; on top of that was a little bubble of air from 6 to 7 mm. in height. The whole therefore appeared to be about 3 cm. in height and to be regularly spherical, with the exception of the part in contact with the rest of the esophagus, which was flat.

It seemed evident that a spasm constricted the opening of the diverticulum during the first hour after a meal; when the spasm ceased, the opening enlarged. The opaque liquid passed through the cardia slowly but regularly for the first half hour without appreciable arrest; a thin opaque thread was always visible extending down into the upper portion of the stomach. A certain quantity of opaque liquid remained in the diverticulum and in the lowest part of the esophagus, its upper level being the same in both places; above this opaque liquid was a column of liquid, secretion or residue or both, filling the greatly dilated esophagus. This stagnation of opaque liquid lasted more than six hours; at that time the height of the liquid was still about 2 cm. in the esophagus and 1 cm. in the diverticulum.

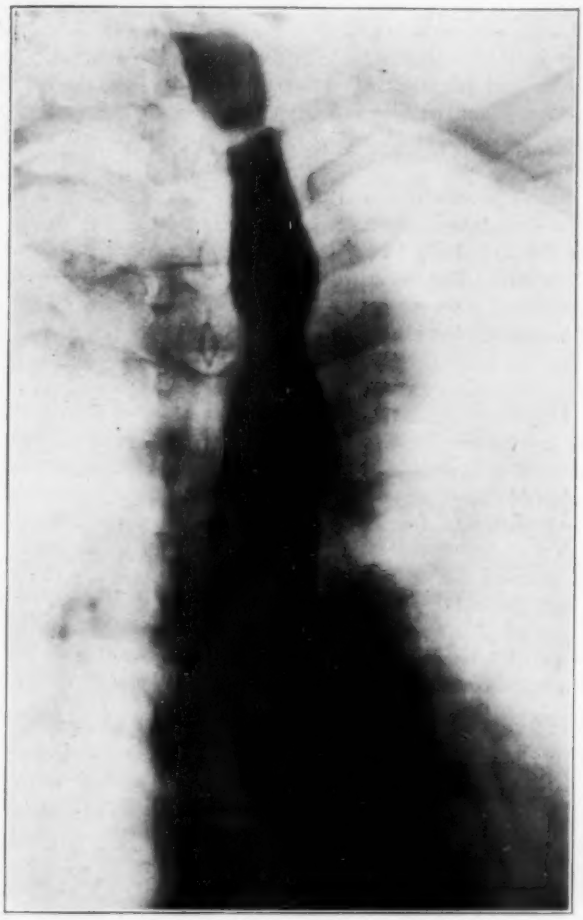
The contours of the whole image given by the barium liquid were regular at the region of the cardia as well as in the region above it; the only irregularity visible was that constituted by the groove separating the diverticulum from the esophagus.

The roentgen-ray diagnosis should be: "cardiospasm" probably with lesions of chronic inflammation; diverticulum of the volume of a walnut, located at about 2 cm. above the cardia, forward and to the right, with a large opening, narrowing itself temporarily by spasm; dilatation of the esophagus; prolonged stasis in the esophagus and in the diverticulum.

Comparison with the examination made in 1920 showed that in four years and a half the following changes had occurred: increase, though not marked, in the volume of the diverticulum, dilatation of the esophagus and more marked stasis of food.

In this type of case there is the pinchcock action at the level of the diaphragm as a most important factor in producing the epiphrenic diverticulum and the dilatation, as demonstrated by Chevalier Jackson.

Vinson published two cases of dilatation of the esophagus combined with diverticulum at the level of the middle portion of the esophagus.



Roentgenogram showing pulsion diverticulum combined with mega-esophagus.

I have not found any case in the literature of Zenker or other so-called pharyngo-esophageal diverticulum combined with dilatation of the esophagus.

CASE 2.—*History.*—R. H., aged 58, complained of difficulty in swallowing especially solid foods. This difficulty was localized at the level of the manubrium and was first present in September, 1926. When he consulted me, the patient said

that when he swallowed dry, that is without the assistance of fluid, he had difficulty. This difficulty had continued to increase, for the patient said that a bolus of food even the size of a nut would no longer pass. Meat especially was swallowed with great difficulty, but when it was in the form of a boiled hash and with a puree of potatoes it passed well. According to the patient, the throat remained full of food, which he could not swallow except when accompanied by several swallows of liquid. The patient declared that he had not had regurgitation or esophageal vomiting. However, he had had aerophagia, for occasionally he was seized with such a heaviness at the lower extremity of the sternum that he felt urgent need of eructating, which relieved him somewhat. After a meal the patient sometimes felt a gurgling sensation in the left side of the neck, in front of the sternocleidomastoid. Since the month of September, he had lost 3 Kg. Between the ages of 15 and 30 years, he had had one attack of bilious vomiting a week.

Examination.—The man appeared to be in perfect health. The breath sounds were somewhat diminished, especially at the base of the left lung. Some râles were heard in the right lung. The heart sounds were normal, but muffled. The abdomen was normal. The urine was normal and the Bordet-Wassermann reaction was negative.

A careful attempt at bouginage failed; the bougie was arrested at 25 cm. from the teeth.

On fluoroscopic study swallowing of bismuth paste showed an obstruction in the lower part of the hypopharynx, with the formation of a pocket opening into the esophagus on the surface of the posterior wall; then the bismuth was seen to pass through an enlarged dilated esophagus, without obstruction at the cardia. The roentgenogram confirmed these observations (fig. 1). At esophagoscopy a diverticular pocket was found with a little transverse slit in the left upper segment, which was the subdiverticular orifice. A diverticular sound "à béquille" entered easily, grazing the anterior wall of the hypopharynx, and passed into the stomach without encountering any resistance.

The history of this rare case of the combination of localized and diffuse dilatation is interesting from the point of view of the pathogenesis of these conditions. Chevalier Jackson has well demonstrated that the chief factor in the etiology of diverticulum is the pinchcock action of the cricopharyngeus muscle. An anatomic factor with an embryologic basis has been demonstrated by Mosher. This same pinchcock action occurs at the level of the diaphragm and is a most important factor in producing dilatation of the esophagus.

COMMENT

But this pathogenesis cannot be invoked in all the cases. It does not explain the cases of congenital diverticulum; it scarcely explains the rare cases of juvenile diverticulum and dilatation of the esophagus in the young infant. Mosher and other authors have shown cicatricial tissue in the region of the cardia. This organic factor with spasm of the cardia is the origin of dilatation. This pathogenesis does not explain the congenital or juvenile diverticulum.

Even in the most obstinate and long-standing organic strictures, for example, caustic strictures, there is never any dilatation approaching the remarkable dilatations of the idiopathic type.

I find in the maze of observations that the cardia and the lower part of the esophagus in at least one half of all cases do not show any alteration at operation or postmortem examination.

Neither spasms of the sphincter ani nor congenital pylorspasm occasions any appreciable dilatation of the rectum or of the stomach, and patients can be completely cured of both by a diatetic regimen, which is not the case with idiopathic dilatation of the esophagus.

The cause of esophageal idiopathic dilatation is still in doubt; more observations of a reliable character are necessary. The theory of tissue malformation of Bard, or the theory of congenital malformation, may well explain cases in which there is scarcely any pinchcock action, as in my case. If congenital malformation is present, this spasm need no longer exist. Embryology demonstrates that the conception of any exaggerated congenital development of the whole length of the organ will extend also to its orifices, and consequently the passage of foods will take place easily.

A case of congenital dilatation of the esophagus in a child aged 6 which supports Bard's theory of congenital malformation was published in the *Proceedings of the Société française de laryngologie*. In addition to the marked dilatation, the roentgenograms showed a mega-sigma.

If my patient continues to lose weight, I shall propose operation on the diverticulum, for then it will be easier to judge the symptoms caused by the mega-esophagus.

DEEP ACTINOMYCOSIS OF THE NECK AND MEDIASTINUM

LOUIS VAN DEN WILDENBERG, M.D.
Professor of Otolaryngology, University of Louvain
LOUVAIN, BELGIUM

The upper half of the neck is the most frequent site of actinomycosis, except the face. Often the two regions are attacked simultaneously. Writers who have studied the question point out the tendency of the mycelian infection to progress toward the surface. Bollinger,[1] in particular, says that the condition resembles tuberculosis so closely that one may mistake it for that disease, but that soon the lesion becomes red and slightly edematous, and finally an abscess collects and a fistula is produced. When the disease is active deep in the neck, the primary lesion is often cicatrized, and only scar tissue remains as evidence of the original infection.

PATHOLOGY

Actinomycosis of the mediastinum is always secondary. The route of penetration of the fungus, according to Bollinger, who first described it in 1877, is either through a tooth or the tonsils or else through the air or food passages. Wolf [2] has always found vegetable debris in the midst of actinomycotic foci; that is natural, since, as Boström writes, the fungus on cereals is preserved for a long time in its full vitality. In the literature one finds authors perplexed to explain the route of mediastinal infection. In my remarkable case the history was clear-cut. The patient had the habit of chewing heads of grain, presumably loaded with actinomycotic mycelia. Once the primary infection has become well established, one can conceive all sorts of ways of propagation for the parasitosis. Deep invasion of the lower part of the neck rarely occurs. I have thoroughly reviewed the literature of recent years, and I have not found any case like this one. The literature consists largely of observations at necropsy. When such propagation occurs, the infection easily extends along the loose connective tissue of the sheaths of the great vessels to the mediastina, and through the latter, the pleurae, the lungs, the heart and the pericardium are menaced. All writers agree that involvement of the anterior mediastinum is rarer than that of the posterior.

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1. Bollinger, Otto: Ueber eine neue Pilzkrankheit beim Rinde, Centralbl. f. d. med. Wissensch. **15**:481, 1877.

2. Wolf, M., and Israel, J.: Zur Actinomyces -frage, Virchows f. path. Anat. **151**:471, 1898.

When the mediastinal dome has been invaded, it is natural that if the infection persists it will lift the subaponeurotic cellular sheaths of the greater and lesser pectoral muscles, and also that it may extend to form a vast "rabbit warren" abscess in the axillary region. The irritation that this produces readily explains the pains radiating to the arms, because the brachial plexus is directly involved.

In the literature one finds necropsy descriptions; a clinical description is rarely given, and a roentgenographic demonstration, never.

Letulle and Hoefnagel [3] relate the history of a man with actinomycosis of the esophagus. The disease had extended along the mediastinum into the right lung and the heart.

In 1915, Paetnold Paul made a diagnosis at autopsy of a generalized actinomycosis which had caused the death of a child, aged 12 years. A primary actinomycosis of the right lung was discovered. A fibrous pleurisy was found on the right side, with a fistula extending toward the surface of the chest. The actinomycotic granulations had spread to the heart and other organs.

In 1907, Merkel pointed out a singular case of actinomycosis which he was not able to identify, even at autopsy. It was only by microscopic study that he arrived at the diagnosis. At autopsy, the pleurae of the entire lower lobes of both lungs were found covered with pseudomembranes. Between the pseudomembranes were found ochre-colored tumor masses the size of a fist, enveloping and compressing the aorta and the esophagus, and extending to the level of the bifurcation. Merkel suggested the diagnosis of endothelioma. Microscopic examination revealed actinomycotic glands almost everywhere which had undergone varying degrees of degeneration, and which were more or less calcified in the center. In certain places, the tumor masses had a deceptive resemblance to endotheliomatous growths.

Lichterfeld observed a man, aged 56, who presented the signs of a pleural empyema. A detailed examination led him to make a diagnosis of actinomycosis of the lungs. At autopsy a synechia was found on the surface of the right lung in the mammary region, between the pleura and the thoracic wall, a hand's breadth in extent. The mediastinum, the pericardium and the left pulmonary hilum were entirely adherent to each other.

Wertheman mentions two cases of generalized actinomycosis. The anatomicopathologic examination in the first case showed a propagation toward the lymphatic glands of the bifurcation, the diaphragm and the pericardium.

Kissling reports an interesting case in a girl, aged 12, who had fever, anorexia, lassitude and a distressing cough. On roentgen-ray

3. Letulle and Hoefnagel: Bull. Acad. de méd. **82**:120, 1919.

examination a dense shadow was seen at the level of the pulmonary hilum. He could not decide whether or not he was dealing with tuberculous adenitis. He also thought of the possibility of a tumor originating in the mediastinum. After some time some bluish subcutaneous nodules appeared. Examination of the pus revealed actinomycotic glandular elements. At autopsy an extensive actinomycosis of the mediastinum and of the mediastinal lymph glands was found; the lymph glands were softened and considerably enlarged, with perforation of the left innominate vein and of the left ventricle. In addition to peri and endocarditis, secondary foci were found in the lungs, kidneys, liver, spleen, brain and skin.

In another patient the disease began with similar manifestations. A dry pericarditis and a left-sided pleurisy developed; in addition, bluish-red nodules were observed on the fingers, the soles of the feet, the nose and the lips. Actinomycotic granulations were found in the pus from the nodules.

At autopsy, mediastinitis and lymphadenitis were found with perforation of the superior vena cava. Numerous metastases were present. It was not possible to establish how these actinomycotic infections had occurred.

MICROSCOPY

The pus from actinomycotic lesions is entirely characteristic. It contains ochre yellow granular bodies of various sizes which have a grossly granular appearance when carefully examined. According to Wolf and others,[4] the infection always appears to depend on the introduction into the tissues of vegetable fragments bearing the parasite.

If one examines these granular bodies under the microscope after crushing them between two slides, they differ according to whether the examination is made with a clinical specimen or with the cultured product. In the first case, the bodies consist of mycelial filaments with here and there small nodular swellings which strangely resemble spores. After culture the swellings are absent, and only the filamentous mycelium is found.

DIAGNOSIS AND PROGNOSIS

Diagnosis.—The diagnosis is rarely made. In my case I thought I was dealing with a cervicomediastinal cyst. The neoplastic type is exceptional and is characterized by an abundant proliferation of connective tissue which, without the presence of the mycelium, it is impossible to differentiate from round cell sarcoma. The actinomycotic nodule often breaks down, and then one discovers the characteristic yellow granular bodies.

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4. Wolff, M., and Israel, J.: Ueber Reincultur des Actinomyces und seine Uebertragbarkeit auf Thiere, Virchows Arch. f. path. Anat. **126**:11, 1891.

To confirm the diagnosis one may have recourse to culture, which is satisfactory only on Sabouraud's medium (gelatin, maltose, meat, water).

Animal inoculation is difficult; however, Mosselman and Lienau succeeded in inoculating rabbits.

The diagnosis can also be made by the complement deviation reaction. The serum of the person with actinomycotic parasitosis contains specific antibodies the presence of which one may exploit in order to establish a diagnosis.

Waksman writes that the morphology and physiology of *Actinomyces* varies with the surrounding conditions.

Prognosis.—Actinomycosis of the mediastinum is of much more grave prognosis than cervical actinomycosis, because of the danger of extension to the adjacent organs. Also, these deep parts cannot drain properly. Pulmonary actinomycosis and that of the heart have an even worse prognosis.

TREATMENT

The chief concern in the presence of a cervicomediastinal actinomycosis should be to prevent the extension of the infection toward the thoracic organs.

Actinomycosis of the mediastinum has a certain tendency to progress toward the exterior. In that event the anterior thoracic wall bulges and an abscess with osteitis is created [2]; but one must not count on that happy eventuality. The surgical treatment is relatively simple if there is no extension to the endothoracic organs; intervention by a surgeon who is an expert in surgery of the lungs and heart will be necessary if these organs are involved.

Treatment consists in the opening of the foci by simple incision and the mechanical removal of tissue masses with a sharp curet or scissors, followed by tamponment of the cavities and fistula with iodoform gauze.

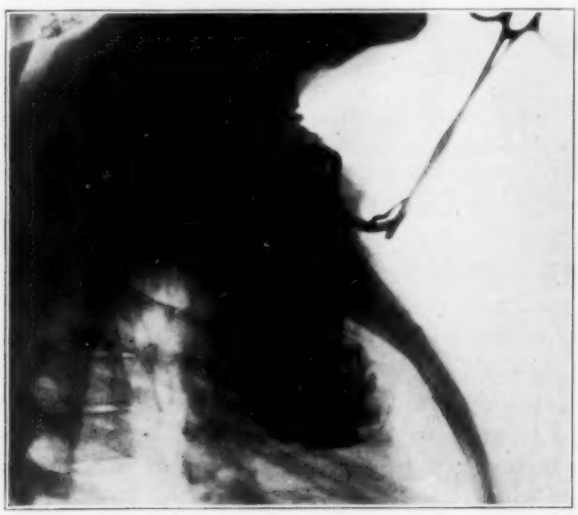
Superficial foci may be cured by potassium iodide alone. Some writers do not consider potassium iodide a specific in the true sense of the word. It does not destroy the fungus, but acts rather on the neoplastic tissues, and in that way on the parasitic foci, which undergo a rapid breaking down and more quickly establish drainage to the surface. However that may be, iodide is efficacious in mycotic infections. In addition to the use of this drug by mouth, it is advisable to make direct local applications, several syringes full of 1 per cent solution being injected. When this has been unsuccessful, even interstitial injections have been made. In certain cases deep roentgen-ray therapy has been advised.

Pneumectomy is said to have given good results.

REPORT OF CASE

History.—Mrs. T., aged 37, of medium build, had been married four years, and had not had any children or miscarriages. Her father was living but her mother died at 54 years of age, probably of pulmonary tuberculosis. The patient had a good constitution, and there was no history of diseases of childhood. She recalled that she frequently chewed heads of wheat, presumably loaded with actinomycotic parasites.

The first symptoms of the present illness began in 1918, with pains in the left shoulder, localized especially behind the outer half of the clavicle. These pains radiated to the arm, which was edematous. After several months a slight swelling appeared in the left subclavicular region, was practically painless and developed slowly, but progressively. The patient was treated in April, 1920, for an attack of rheumatism (hot compresses and salicylates). She then consulted



Roentgenogram showing deep actinomycosis of the neck and mediastinum.

a surgeon, who operated on her after six months of observation. At that time the tumor was the size of a hen's egg, and the surgeon thought it was a tuberculous gland. The first operation was performed in April, 1920, and was followed by drainage for three weeks and subsequent cicatrization.

Up to 1925, the patient had felt normal. Then new intermittent pains appeared that seemed to yield to the administration of iodide of iron by mouth. Four months before the patient came under my observation, a new swelling had appeared under the old scar. Pains with brachial radiation had reappeared. A tumor as large as the first had developed in the subclavian region, extending upward almost to the level of the left lobe of the thyroid, and downward into the suprasternal notch. It was at this time that I saw the patient. A diagnosis of mediastinal cyst was made and an operation was performed.

Operation and Course.—On June 10, 1926, a left-sided collar incision was made through the skin and fascia; the sternomastoid was then liberated and incised. This procedure exposed a large encapsulated and fluctuating tumor.

The superior dome was dissected and the tumor separated from the vessel of the neck. In the course of the work of dissection, the thick but rigid sac yielded, and a seropurulent fluid escaped which resembled that of a cold abscess. At the same time a flood of serous secretions appeared which contained conglomerate granular bodies varying from gold to sulphur and orange-yellow in color. These were the granular bodies typical of actinomycosis which had invaded the mediastinum. The sac was carefully dissected to the lower level of the neck, which exposed the widely open mediastinum. Here masses of the golden bodies could be collected with a spoon. At this time sounds were heard which were characteristic of pneumothorax.

Iodoform gauze drainage was used, and a drainage tube was inserted into the mediastinum, the latter for use in making lavages with a 2 to 5 per cent solution of iodide. In addition, the patient was given 5 Gm. of iodide a day by mouth.

The roentgenogram, made by Jules Francois, showed clearly that the anterior mediastinum was totally invaded. It bears witness to the integrity of the posterior mediastinum, and seems to prove that up to that time the heart and lungs were not affected.

The patient, having been submitted to intensive treatment with iodide, internally and externally, was completely cured of this extensive actinomycosis of the neck in two weeks. The lavages of the mediastinum brought back only insignificant quantities, which diminished day by day.

The patient, reassured, agreed only with great reluctance to the roentgen-ray therapy that I felt I could recommend as a guarantee of definite success. She was subjected to several treatments with deep irradiation, and recovered completely.

DISCUSSION ON DR. L. VAN DEN WILDENBERG'S PAPERS, PULSION DIVERTICULUM COMBINED WITH MEGA-ESOPHAGUS AND DEEP ACTINOMYCOSIS OF NECK AND MEDIASTINUM

DR. WILLY MEYER, New York: Diverticulitis is found in the course of the entire gastro-intestinal tract, if the esophagus is included. From the pharynx down to the sigmoid this disease is found, and, according to its situation, is giving the patient either real trouble or sometimes little trouble. The diverticulitis as it presents itself to the specialist and surgeon at the neck is one which can torment the patient intensely.

Referred to the surgeon for help are principally the diverticula of the upper part of the esophagus, at the neck. It was extremely interesting to me that Dr. Imperatori has attacked this diverticulum by the endo-esophageal method. There is no borderline specialty more closely connected with surgery, as far as the bronchi and the esophagus are concerned, than peroral endoscopy. The latter requires a great deal of patience and perseverance. It is easy to comprehend that an expert who is careful can introduce the esophagoscope into the diverticulum, grasp with his forceps the bottom of the same, and with gentleness turn it inside out and see it right before him. He is able to put a ligature around from within, and then the whole procedure is finished. Such a procedure is, for some female patients, when the cosmetic result — the avoidance of a scar — is of importance, a godsend.

Surgeons have learned that, with local anesthesia and in a two-stage procedure, one can now do a safe operation in these cases; but it leaves a scar.

It is self-evident, that the bloodless endoscopic method cannot be employed in every case of this class as a routine.

In regard to actinomycosis it is known, fortunately, that the disease is submissive to and can be cured by the iodines.

Dr. J. D. Kernan, New York: I saw the case of actinomycosis of the lung that Dr. van den Wildenberg was kind enough to mention. It was presented to me as a case of foreign body in the lung. A young boy who had been out in the country playing around on the ground developed pulmonary symptoms, cough and sputum, and other signs. He was brought into the Babies' Hospital in New York for purposes of bronchoscopic examination. The bronchoscopic examination revealed what appeared to be a foreign body in the right bronchus. This was removed and proved to be some substance about the size of a pea, the nature of which could not be made out. It seemed to be formless débris. Bronchoscopy was performed fourteen times during those eight months.

The boy finally died from pneumonia in the other lung. Autopsy revealed a complete excavation of the right lung.

This was a case in which all therapeutic efforts were in vain. He had the bronchoscopic treatment, the roentgen-ray therapy and treatment with iodides, and yet the disease process went on to a fatal issue. The roentgen-ray series was interesting. It showed at the beginning a small abscess in the lower lobe of the right lung which steadily expanded until the whole chest was affected right to the apex of the lung.

Dr. John F. Barnhill, Indianapolis: Cases of this type are unfortunate, chiefly because, as in the cases I have had, the diagnosis is difficult, and ultimate spread of the disease to distant organs often occurs. Spread of the disease to the abdominal tissues occurs oftenest.

Dr. Chevalier Jackson, Philadelphia: Referring to the operation for diverticulum mentioned by Dr. Willy Meyer, the operation by the endoscopic method, devised and carried out by Dr. Imperatori in his three cases, is a most remarkable procedure, full of promise.

In regard to actinomycosis, some twenty-five or twenty-eight years ago, I saw a patient in Pittsburgh with what I took to be a syphilitic infection of the nose. It extended backward and destroyed all of the upper jaw. This was before the days of the Bordet reaction, and the diagnosis of syphilis could be confirmed only by the therapeutic test. Mercury did not have any effect on the process. When potassium iodide was used, some effects were noticed, but the patient was not cured. Eventually, the fungus was found, and the diagnosis of actinomycosis was established.

Clinical Notes

ABERRANT BRANCHIAL CYST ENCROACHING ON THE GLOTTIS AND CAUSING SUFFOCATION AND DEATH*

W. R. Watson, M.D., Philadelphia

A woman, sent to the Episcopal Hospital, Philadelphia, on Dec. 12, 1926, because of difficulty in respiration, had apparently not exhibited sufficient laryngeal symptoms during six months of her illness to prompt her physician to make an examination of the larynx. He was satisfied that her symptoms were those of asthma. She died shortly after admission to the hospital, before consultation with the laryngologic service could be obtained. The cause of death was discovered at autopsy.

The patient gave a history of having suffered from attacks of shortness of breath in the month of May, 1926, and at that time she first consulted a physician. The attack would start with difficulty in breathing, followed by actual dyspnea. The difficulty in respiration became gradually worse and she suffered from frequent attacks of colds with cough and without expectoration. Soon she became confined to her bed.

On Dec. 9, 1926, another severe paroxysm started, with sore throat and shortness of breath, and shortly thereafter dyspnea and exhaustion overcame the patient; then the family physician sent her to the hospital with the diagnosis of bronchial asthma.

The patient was admitted on December 12. She had to be propped up in bed and was cyanotic. She was uncomfortable, although she had been given a hypodermic injection of epinephrine hydrochloride on arrival. The pulse was weak, and the patient was much exhausted. She did not appear to be laboring for breath to any great extent.

Examination found the chest expansion fair, the accessory muscles of respiration not active and no marked labor on inspiration or expiration. The lungs were resonant throughout. The breath sounds on auscultation were normal and would suddenly stop because of a cessation of breathing. There was no bronchial wheezing or râles, and no prolongation suggestive of asthma. Throughout the chest the inspiratory cycle would start out normally and then suddenly stop, and the patient would be unable to get more air into the lungs until she expired. This would repeat itself. The heart sounds were distinct but weak. The apex beat was barely palpable in the fifth interspace just outside the midclavicular line. Slight enlargement was observed to the right. The aortic second sounds were distinct. Murmurs were not present. The heart rate was slow. Pulmonic sounds were not snappy, and there were no shocks or thrills.

At 7 a. m., on December 13, the patient became very cyanotic, the pulse was not detectable at the wrist and respiration was slow—eight per minute. She did not react to stimulants, nor was she laboring for breath. She died at 7:15 a. m.

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*Reported before the Otological Division, College of Physicians of Philadelphia, March 16, 1927.

The observations at autopsy were: abscessed branchial cyst, cysto-adenoma of the thyroid, chronic endocarditis, acute congestive splenitis, chronic adhesive pleuritis and vesicular emphysema.

The laboratory report on the branchial cyst was as follows: walls fibrous; lymphoid tissue covered with a single layer of compound columnar epithelium; cyst filled with pus in which was found undifferentiated cocci; cultures of the heart and spleen were negative.

The patient was in the hospital only seven hours, from midnight on, at a time when the laryngologic staff was not available.

Examination of the specimen obtained at autopsy, as shown in the illustration, revealed that owing to some embryologic deficiency the cyst seemed to be an integral part of the larynx and that the inferior extremity of the larynx formed a sort of "ball valve" obstruction over the glottis. The cyst pierced the larynx at the site of the right ventricle and proceeded in a downward and inward direction with its bulbous extremity on the vocal cords. Evidently, until six months previous to the symptoms, the cyst was not more than a residual

Branchial cyst obstructing larynx; *A* indicates upper extremity; *B* lower extremity.

branchial cleft anomalously located and not large enough to cause any symptoms. Apparently at that time the cyst became infected — possibly by way of the lymphatics — and produced a sac of pus which encroached on the glottis.

It was interesting that during her illness the patient stated that she was greatly relieved by hypodermic treatment, but a record was not obtained as to the nature of the injections; perhaps morphine and epinephrine hydrochloride were used.

The question arises as to what would have been the proper procedure had the patient been examined and the condition discovered during her life. Lying within the ventricles and completely filling the fossae innomatae, the cyst might have been mistaken for an exceptionally large papilloma, in which case a misdirected effort to twist it off would have produced disastrous results. Careful examination should have revealed the condition, and tracheotomies could have been performed until the patient regained sufficient strength to permit a more formidable operation of exenteration.

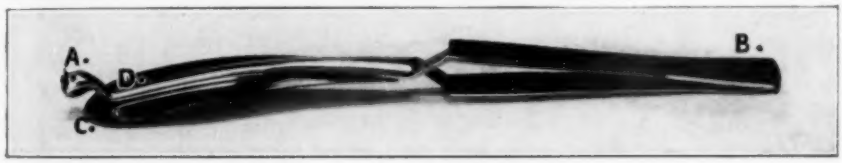
It was more or less unfortunate for the patient that her voice was never affected since, if she had suffered from aphonia at any time in her illness, it would have led to an examination of the larynx and the probably detection of her condition.

COMBINATION TONSIL FORCEPS AND TONGUE DEPRESSOR

MAXWELL FINEBERG, M.D., MONTREAL

When difficulty is encountered in removing adherent tonsils by surgical dissection, it will be readily admitted that the difficulty is greatest at the inferior pole. The reason for this, from the anatomic standpoint, is twofold: First, there is more surrounding lymphoid tissue at the inferior pole, and, second, the base is the thickest and most unruly part of the tongue. This thick part often blocks the view of the operator and forces him to work in the dark, behind the upcurled tongue; he therefore often leaves small tonsillar tags in the inferior pole.

With this in mind, it occurred to me that the instrument which was being used to grasp and hold the tonsil might also be made to depress and push forward this thick base of the tongue. Some operators have used an ordinary tongue depressor in these cases, but, undoubtedly, the addition of another instrument in an already obscured field is not advantageous.



Tonsil forceps and tongue depressor.

A opens at an angle which permits the seizing of the tonsil in the horizontal plane when the handle *B* is held at a slightly higher level. This allows the use of the instrument as an ordinary forceps if the spatula is not required.

The curved angle of the spatula is such that after the tonsil has been seized in the manner described, the tongue in its whole length is depressed if *B* is lowered; because of a slightly greater angle from *C* to *D*, very little pulling on the instrument is required to push the base of the tongue forward after it has been depressed. There is ample space between *A* and *C* (1 cm.) to allow the cutting or freeing instrument to reach all parts of the base of the tonsil. The spatula is wide enough to depress the tongue completely but is narrow enough to allow an ordinary snare to pass around it.

The double angle at which *A* rests on the spatula allows a full view of the operating field at all times; this is an advantage in itself over the ordinary forceps, which have their grasping teeth in the same plane as the rest of the forceps.

The instrument was made in Vienna by H. Reiner while I was studying there.

Progress in Otolaryngology

Summary of the Bibliographic Material Available in the Field of Otolaryngology

FUNCTIONAL EXAMINATION OF HEARING

DEAF-MUTISM AND THE EDUCATION OF THE DEAF: ANNUAL REVIEW OF THE LITERATURE *

ROBERT SONNENSCHEIN, M.D.
CHICAGO

As in the review that appeared in January, 1927, I again wish to call attention to the fact that American otolaryngologists are contributing a large proportion of the work on functional testing of hearing; this is in contrast to what happened in the years prior to 1926. Another striking fact is that so little has been published in the literature of this year regarding the use of audiometers. My impression is that, in view of the great interest which apparently was manifested in audiometers (as evidenced by the number of articles dealing with them and with their clinical application), the journals of 1927 deal with the subject much less than they did in 1926. In the German literature, however, several articles have appeared, describing various types of audiometers, none of which, so far as I can see, are as well developed as those used in this country. There seem to be fashions in medical practice which change with the times, just as complete reversals of form in the styles of clothing often occur. Perhaps the coming year will again bring forth more articles dealing with audiometers and their application. While these instruments are of great value in many ways, I am still inclined to the view that they are not indispensable to functional testing, nor do they give certain data which can be obtained by carefully performed tests with tuning forks Both types of appliances have their advantages and limitations, and both are valuable, perhaps especially so when one is used as an adjunct to, or supplement of, the other.

The development of the new apparatus known as the "Osiso" has probably been the greatest single advance during the past year in the way of addition to the instrumentarium, especially for the teaching of the deaf. Dr. Max A. Goldstein, who has devoted many years to care-

* This review includes articles published from November, 1926, to October, 1927. Some of the foreign journals do not arrive in time for the summary of the current year and they are reviewed the following year.

ful, painstaking work with the deaf and deaf-mutes, is giving much time and energy to the study of the practical application of the Osiso as an aid to these unfortunates.

RELATION OF FUNCTIONAL TEST TO DEFECTS IN SPEECH

In a statistical report by Dr. Shambaugh and his co-workers,[1] attempt is made to analyze the function of hearing to determine particularly relations between the various functional tests and their relation to the problem of defects in speech. The Schwabach and Rinne tests were performed in all cases. The Rinne test may be positive in children as well as in adults, even though the defect in hearing is severe enough to necessitate instruction in a school for the deaf. Both forms of deafness, the congenital and the acquired, may be absolute, as shown both by the audiometer and by the tuning forks. In seventy-five cases in which remnants of hearing were found with the audiometer, fifty-eight persons showed total deafness by both bone and air conduction when tested by the tuning forks. Thirty-five of these had cases of congenital deafness showing that developmental anomalies responsible for congenital deafness often leaves remnants of hearing as do acquired defects.

One hundred and ninety-seven children were studied in comparing the results obtained with the audiometer with those obtained by other tests and with the presence or absence of defects in speech. Thirty-five had total deafness, proved by all tests, of which thirty-one showed marked defects in speech. This may be explained by the fact that the defect in hearing developed after the patient had acquired the art of speech. None of the patients with defective hearing as proved by the other tests were found normal when tested with the audiometer, and when remnants of hearing were present, they were always brought out by the audiometer. A person who is practically without a sense of hearing is likely to have some defect of speech, which may be a voice of low or high pitch, or a mixture of both; often little remains that resembles a human voice. "No children without marked speech defects showed total deafness for the audiometer but hearing for other tests."

Results of the study showed that children whose speech is not markedly defective usually have remnants of hearing, as disclosed by tests with the fork and with the audiometer. Most of these remnants of hearing are below or both above and below 2,000 double vibrations, but none were above 2,000.

This work of Dr. Shambaugh and his assistants will prove most valuable, and forms an admirable complement to their contribution of

1. Shambaugh, George E.; Hall, Alice K.; Hagens, Elmer W., and Holderman, Jacob W.: Supplementary Statistical Studies of the Children in the Chicago Public Schools for the Deaf, Arch. Otolaryng. **5**:209 (March) 1927.

the previous year. The article contains tables and so many details that it is difficult to do justice to it in an abstract. In order to be appreciated, it should be read in its entirety.

USE OF THE VOICE AS A HEARING TEST

Testing the hearing capacity of the ear by the voice is just as important, if not more so, than any of the other tests.[2] One is able to obtain quick and comprehensive information regarding the hearing capacity as a whole and also regarding the particular seat of the disease. There are many limitations to the use of the voice as a sole testing method, as in deaf-mutes, high grade impairment of hearing or complete unilateral or bilateral deafness when the impairment of the entire tone scale is to be ascertained.

Otologists are generally agreed on the use of the whispered voice in preference to the spoken voice, because it is easier to regulate its timber, pitch and carrying power, because the available office space is usually not sufficient to permit adequate loud voice tests, and, finally, because it is impossible to prevent the perceiving of sounds by the untested ear when the spoken voice is used at close range.

Consonants are possessed of higher testing value than the vowels because of their lesser intensity. The highest vowels and consonants are *i* and *s* and the lowest *u* and *v*, respectively.

Wolf, in 1871, was the first to substitute vocal sounds for musical sounds by using two syllable words arranged in three groups, high, medium and low, according to the prominence of at least one of the testing sounds. He used few words, varying the tone color as much as possible, and employed the same consonant repeatedly to prevent substitution with others. The objections to his method are that the voice test depends primarily on the consonants which are the key. Repetition of the word and the use of only a few selected words may easily permit guessing after a little practice by an intelligent patient, who may in reality not even hear the basic consonants in these words. The use of numerals for testing as suggested by Bezold is defective for similar reasons—few words and the use of the same content. The use of numerals has value in its main object, but does not give any consideration to the acoustic picture. The next advance made by the Dutch and Germans was to use words containing vowels and consonants of the same pitch and intensity, resulting in a word belonging to one tone region which it would be difficult to confuse or guess. The difficulty with this method was that not enough words with a definite meaning could be found in the respective languages. Bárány's "changing sound" method is the

2. Nussbaum, David: An Improved Method for Testing the Hearing with the Spoken Voice, Laryngoscope **37**:176 (March) 1927.

most perfect instrument for voice testing today, because it combines the use of living speech with the principle of pure air conduction. The words consist of constituted sounds of uniform acoustic quality, with the exception of one which is changeable. These are the basic elements of the words that make up the spoken language. A synthetic table of words was constructed based on this principle. Some of the words are unintelligible, however, and contain strange suffixes which distract the patient's attention from the key sound. Lampert endeavored to correct these weak points by making all the words intelligible and having a strict uniform pronunciation, excepting the key or testing sound. The words are strictly of the same pitch, timber and carrying power, and the one sound that affects the perception is alternately transmuted from one end of the word to the other. The words are arranged in two main divisions—vowels and consonants—and they are then grouped in rows of from three to ten words each. The beginning and ending of each row is represented by sounds at both extremes of the tone scale. The test words are part of the average person's vocabulary, and therefore readily perceived, understood and repeated. The key sound is changed alternately from the beginning to the middle and then to the end of the word in order to eliminate guessing. The article is accompanied by the groups of words used in Lampert's modification of the voice test.

Dr. Macfarlan [3] presents the different variables as well as the difficulties encountered with the voice test of hearing in order to eliminate them or reduce them to their minimum effect. Two points are considered in studying the voice test. One is that of stimulation and is composed of vowels and consonants with a pitch range between 300 and 3,000 double vibrations. The second, the subjective part of the voice test is the perception of speech by hearing. The mental and emotional state of a person may produce marked variables in the voice test observations. There is a probability of error in the interpretation of speech which is less frequent when intelligible words or phrases are used, or when patients are examined who have developed word memory. Care should be used in technic and in the correct interpretation of slow responses; frequent repetition should be avoided so as to guard against memory, and simple familiar monosyllables should be used, as enumerated in the accompanying table.

In discussing the voice as a hearing stimulus, the fundamentals of the spoken and whispered voice are presented. The variability of the amplitude of the voice and the inability to produce definite monotones greatly reduce the value of the speech tests. The examiner cannot duplicate his testing stimuli at consecutive sittings. Words and sen-

3. Macfarlan, Douglas: The Voice Test of Hearing, Arch. Otolaryng. **6**:1 (Jan.) 1927.

tences have colorful sound pictures due to the complexity of pitches and the amplitudes of the vowel sounds, which is a big factor in the difficulty of interpretation by one with impaired hearing.

In the choice of test words and numbers, Macfarlan gives two tables of monosyllables, words of low and of high pitches, and suggests the use of numerals from 1 to 10, excluding 7, which is a polysyllable and which might be guessed by a patient conscious of the test numbers. It is difficult to control the amplitude of the voice. Whispering reduces the intensity of the vowels, but consonants are not affected. Enunciation, accident, inflection and articulation also enter into the test as variable factors. The acoustic properties of the room in which the examination is made may alter results, and the examiner should mention whether extraneous factors of this nature have to be considered in interpreting results of the test. The factor of auditory fatigue must also be considered. Word tests, however, do not fatigue the patient as rapidly as single tone tests do, for instance, the tuning fork tests. Macfarlan presents clinical observations with word tests in catarrhal and nerve deafness with accompanying charts to show results. He suggests a technic for the voice tests which embodies the following points: a record sheet, an examination of the ears, nose and throat, mention of the type of word or number of stimuli used, a quiet room free from extraneous noises, gentle pressure of the finger to the untested ear, distances marked off on the floor, approach of the patient from inaudible to audible distance, a preliminary test to familiarize the patient with the experiment, avoidance of successive repetitions, variety of test words to be used for each distance, postponement of test if mental or physical variables arise, and notation concerning variables which arise during the test. The speech interpretation tests determine the ability to interpret speech at the hearing threshold, with a record made of the words as interpreted. He emphasizes the importance of rigidly maintaining an ideal technic.

Macfarlan says that the voice test is not of great value in differentiating different types of deafness, since high voice sounds are heard nearly equally well in all types of deafness at the interpretation threshold. High tone deafness cannot be determined satisfactorily, as the voice is not sufficiently high in its upper limits to test it. Interpretation, however, is somewhat better in catarrhal deafness than in nerve deafness, especially with the high tones.

The voice test as compared with the other tests of hearing is more satisfactory and most direct for determining the hearing of speech. It does not require expensive apparatus, but it does require intelligence on the part of the examiner.

The author recommends the following modifications of Whipple's tests for examination of groups:

1. Numbers from 1 to 100 are divided into ten columns of ten numbers each or into monosyllables given in the table accompanying the article.

2. The pupils are supplied with pad and pencil and seated in an arc sidewise to the examiner, first with the right and then with the left ear toward him, at a distance at which only 90 per cent of the test words are audible to the normal ear.

3. The seats are kept away from the wall so as to avoid reflection and the intensity of the testing voice is held within limits that make hearing in the untested ear impossible.

4. The words heard are written promptly, and a dash is made for the words not understood or heard.

5. A test word is given every three seconds, and a fifteen second rest is given between each series of ten stimuli. The whole test consumes only fifteen minutes for the class.

6. Tabulation ratings can be made according to the percentage of correct answers. The average of correct answers is taken as the normal. This test is recommended for use in schools.

A new method for measuring hearing of speech quantitatively has been devised by Macfarlan and Harvey Fletcher. It is a variation of the phonograph with the voice sounds transferred to an electric circuit. The tones are transmitted from the needle in contact with a phonograph record made by vertical impressions in the groove to a telephone circuit having a special diaphragm practically free from distortion of speech sound. Graded variation of the intensity of the sound is accomplished during the manufacture of the record. The speed of the disk is constant. A series of numbers is spoken from the record with a pause between each one sufficient to permit the numbers heard to be written. The intensity drops one degree for every five numbers. The sound intensity for every five numbers being known, the percentage of the patient's hearing can be determined directly by observing when he fails to hear or to record. Ten or more receivers may be used simultaneously and as many subjects can be tested at the same time. The test can be run through for both ears in ten minutes. It has been found to be simple, rapid and free from any confusions or uncertainties in testing school children.

The objection commonly stated that the subjects hear by bone conduction because the receiver is held close to the ear is not practical, because the sounds produced are transverse and not longitudinal vibrations and so are transmitted only slightly through bone. This is true also of the audiometer. One of the great shortcomings of the audiometer, however, is the lack of a satisfactory method for testing bone conduction with this instrument. In order that tones from the receiver may be transmitted by bone conduction, an intensity equivalent necessary to overcome a 70 per cent deafness must be used.

Macfarlan concludes that in spite of the many variables in the voice test because of the inability to produce a dependable standard and ponderable stimulus by voice, and in spite of the inability to determine pathologic changes of hearing because of the limited field of vibrations of the voice, the test is most valuable for testing the ability to interpret speech and the distance at which speech can be heard. As hearing of speech is the most important function of the ear, the voice test is a direct method for testing this function. The higher mental factors, such as attention, alertness and other factors, should be considered when testing the most simple sensory phenomena of hearing.

I am in accord with the author's views regarding the difficulties and defects of testing the hearing with the voice. On the other hand, I have often emphasized the fact that the criterion of the function of the ears is the ability to understand speech, and even though the patient is unable to hear the lowest and highest tones, if the middle octaves are preserved, the voice can be heard. If during the testing, precautions are observed, such as having the untested ear occluded with the finger or otherwise, having the eyes averted so that they cannot read the lips of the speaker, avoiding all contact of the arms or body with the walls or fixed structures in the room, and using the unaccentuated whisper or conversational tone, it is possible to gain a good estimate of the ability to hear from a practical standpoint.

HEARING BY TOUCH IMPRESSIONS

Professor Gault [4] has been working on a method whereby the speaker's vocal vibrations are instrumentally communicated to the fingers or palm of a subject in such a manner as to be felt by a considerable group of persons simultaneously. The words are not only felt, but are also associated with meanings so as to enable the subjects to understand speech through touch impressions. This method is also used to aid the mute to get control of his vocal expressions; when he is able to feel his own voice and compare it with that of the speaker, he is able to check and guide himself to speak correctly and to control his own vocal expression.

Homophenous words which cannot be distinguished by the lip reader can be discriminated by the touch with but few exceptions. The lip touch reading enhances the pupil's ability to read lips without instrumental aid outside of school and after school days are over. Professor Gault demonstrates a case of touch reading. The instrument used has been manufactured by the Bell Telephone Laboratories in New York City. He believes the time will come when these transmitters will be connected to each desk in the school rooms for the deaf, and that this method will greatly facilitate instruction. There

4. Gault, Robert H.: Hearing by Touch, Laryngoscope **37**:184 (March) 1927.

will also be an improvement of vocal expressions and in the reception of music. After two or three years of such instruction, it is hoped that the pupil will be able to take his place in the regular public school and compete successfully with others there.

COOPERATION OF THE DEAF

Dr. Berry [5] shows how the deafened are helping otologists as well as themselves through the work of the various branches of the American Federation of Organizations for the Hard of Hearing, many of whose members are people with impaired hearing. Recreation of the group (as hikes, dances and suppers) has been an important factor in the rehabilitation of persons who are hard of hearing. Adjustment of employment problems through employment agencies and regular classes in lip reading have helped these people considerably. Their prevention program has been valuable. With the aid of many prominent otologists, great numbers of school children have been examined and aided considerably by proper treatment and environmental corrections. Through these methods as well as through financial aid in supplying apparatus and means for testing the hearing of school children and the following up of the cases, the federation is a powerful ally to the otologist in his work. On the other hand, the aid of the otologist is necessary, and his cooperation and service are sought by this organization.

THE OSISO AND SPEECH GRAPHS

The Osiso is a highly efficient oscillograph.[6] The latter, which has been known for more than a generation, is an instrument capable of recording instantaneous values of electric currents. Osiso is a coined word in which "os" stands for oscillation, "i" for instantaneous, "s" for scope and "o" for optical efficiency. The instrument is compact, weighing 14 pounds (6.4 Kg.), can be turned upside down without changing its characteristics, and is only 6¼ inches wide (15.87 cm.), 9 inches high (22.8 cm.) and 19½ inches long (49.5 cm.). It is designed with a multiple wave distributor permitting four waves of speech to be projected side by side so that two waves do not coincide even though one speaks consonants into the microphone.

The outfit installed in the Central Institute for the Deaf included a broadcasting studio amplifier and microphone, a standard Osiso with motor driven viewing attachment and phonoscope distributor, a daylight loading rotating drug film holder, a slow speed long film holder, batteries and switches. A four pole double throw switch was used to change from

5. Berry, Gordon: How the Deafened are Helping the Otologist, Ann. Otol. Rhin. & Laryng. **35**:1082 (Dec.) 1926.

6. Legg, Joseph W.: The Osiso as a Phonoscope for the Deaf, Laryngoscope **37**:602 (Aug.) 1927.

quadruple wave visualization to duomicrophone visualization, enabling instructor and pupil to talk into their respective microphone at the same time, and to see both wave forms side by side. This apparatus should make it possible for the deaf to improve their speech and to learn to visualize it over the telephone or radio.

The early races realized the value of perfect phonetics, and some of these early ideals are still observed in the expression of spoken language. Today phonetic analysis with the various instruments and devices which it has at its disposal is an independent science. The symbols which represent recorded speech have always taken their origin from the form of familiar objects or the shape of the organs of articulation in their varied positions. Attempts are now being made to record the phonetics of speech by the actual graphs of waves of motion as created in the production of voice. Goldstein [7] presents a review of the various methods and the advance in the study of graphs of speech from the time of Helmont in 1667 to the present day, with special mention of the works of Koenig, Bell, Marey, Crandall and Sacia. The introduction of electricity as an aid has presented a new era in the study of the graphs of speech. The latest development is the "Osiso," invented by Legg, which is a portable and modified form of oscillograph.

A preliminary report of the research work undertaken at the Central Institute for the Deaf with this instrument includes the following points:

1. The development of a new phonetic system of all vowel and consonant elements.
2. The preparation of phonetic text books for the education of the deaf child by this system.
3. The study of the pathology of speech as recorded by speech graphs in defective phonation.
4. The instruction of the deaf child to correct his own speech as made possible by the actual visualization of his defective speech graphs simultaneously with the model speech graph of the teacher.
5. The more accurate analyses of qualitative and quantitative phonetics as presented by sensitive osisograms.

By means of the Osiso by which the most delicate sound waves produced in the phonation of elements of speech are translated into light waves of accurate character, shape and size, the eye of the deaf child is being educated to a new thought and to a finer appreciation of the physiologic acts in which he is engaged in the production of phonation. By this means he is also able to visualize his own speech mechanism, which is of considerable psychologic value. Attempts to standardize amplitude and pitch are being made by means of introducing a sensitive meter and using b flat as a standard of pitch so as to enable the con-

7. Goldstein, Max A.: Seeing Sound, Laryngoscope **37**:551 (Aug.) 1927.

struction of a phonetic alphabet of graphs of speech. The graphs are photographed by specially constructed cameras, and the films are developed and printed.

The simplicity in translation of the light graph from the sound wave, and the ease and rapidity of photographic reproduction is an unusual feature in the performance of the Osiso. Trained teachers of speech have been selected to make individual graphs of their several elements of speech in order to produce model graphs of every vowel and consonant element of speech. The composite osisogram of the several experimenters when graduated to a normal intensity differed little from that of the individual voice. "The appreciation of voice vibration by the sense of touch is a less delicate messenger to the brain than the recognition of the osisogram by sight." The objective now is to familiarize the deaf child with the model osisograms that represent the elements of sounded speech so that he can visualize them as the symbols of the alphabet. It should be possible to teach the phonetics of speech to the deaf child as readily as reading or writing by the usual symbols of the alphabet. Osisograms present a new and unusual phase of phonetic research that promises to develop another valuable chapter in the speech education of the deaf. The article is accompanied by numerous osisograms of the alphabet and photographs of the Osiso as well as the instruments formerly used for phonetic visualization.

At the beginning of this review I called attention to the fact that I believe the introduction of the Osiso is the most striking point in the advance made in that phase of otolaryngology with which I am now dealing. Much credit is due to Mr. Joseph W. Legg for developing the apparatus and to Dr. Goldstein for his careful and painstaking work in utilizing it for the benefit of the unfortunates for whom he is doing so much. He points out in his paper that the Osiso opens many avenues in the teaching of the deaf child.

By means of a mouth-piece connected with tubing, and the latter closed at the opposite end by an oiled silk diaphragm, tracings of the voice are obtained on a kymograph through movements of a delicate lever. The child is encouraged to speak into the apparatus and to imitate the curves made for various words by the normal speaking person. Scripture [8] is of the opinion, in concordance with the views of Freunthaller, that instruction in speech should be begun at the age of 3.

This method seems to be excellent, but I wonder whether the Osiso does not offer more advantages in the facility of its action and the ease of its manipulation. On the other hand, the cost of the Osiso is probably far greater than the simple apparatus used by Scripture.

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8. Scripture, E. W.: The Use of a Graphic Method in the Teaching of Deaf Mutes, Ztschr. f. Hals- Nasen- u. Ohrenh. **19**:27 (May) 1927.

EYE MUSCLE REFLEX

Froeschels [9] publishes an article that, in a way, is a continuation or rather a further development of one that appeared in the same journal last year. In that communication, the author described a nystagmus-like movement of the eyes when the tones of the Urbantschitsch harmonica were conducted directly into the patient's ear by means of a hearing tube. The movements of the eyes were always away from the source of the sound and then back to it, but never in a reversed direction. They thus resembled the reaction of a fistula symptom without the fistula being present. A careful observation with a lens showed that the oscillations are sometimes rotatory and not always horizontal as at first believed.

The author gives the results of tests in a number of cases, which show that, except in one test, the vestibular apparatus was responsive to stimulation and that the patients claimed to hear the tones which produced the movements of the eye muscle. In a previous communication, Froeschels noted that after a prolonged examination the ocular movements failed to be elicited, probably due to fatigue of the central tracks.

The author cannot explain the movement of the eye muscle, but he quotes Tullio, who is of the opinion that the noise (!) is the physiologic stimulant of the semicircular canals. He claims to have shown that all movements of the eyes, head, body and extremities which arise from mechanical stimulation of the semicircular canals also can be produced when sounds are conducted to the ears of patients. With severe traumatism to the labyrinth also there is a turning of the head to the side opposite the one to which the sound is being conducted. The movement of the head as well as that of the eyes is described by Tullio as being due to stimulation of the utricle and sacculus. Froeschels thinks that the careful work of Tullio shows that one can get the movements of the eye and head in animals as well as in man.

The author feels that the fatigue symptom of this reflex permits the conclusion that at one time in the development of man movements of the eye and of the head of a reflex character definitely followed tonal stimulation, and its persistence in deaf-mutes is rather a sign of atavism.

A number of eye reflexes have been described in recent years, the best known being that of determining in a small infant the presence or absence of hearing. In this test, a high pitched tuning fork is used, but, as was pointed out by me a number of years ago, there are fallacies in that the high pitched sounds are carried over to the opposite ear,

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9. Froeschels, Dozent: An Eye Muscle Reflex in Deaf Mutes Elicited by Noises, Monatschr. f. Ohrenh. **61**:776 (July) 1927.

that the test must be done in such a manner as not to attract the attention of the little patient, and that one does not definitely know in which ear hearing is present. The Froeschels test is interesting in that by means of powerful sound impulses a nystagmus-like movement of the eyes is observed in deaf-mutes. The author is a most industrious and resourceful worker, and his research has added many valuable facts in the teaching of deaf and deaf-mutes, but it is impossible to state at present to just what extent this new test will prove of service in clinical experience.

If it is true, as Tullio claims, that auditory impulses are physiologic stimuli to the semicircular canals, then the whole conception of the physiology of the labyrinth needs revision. Surely these statements must be investigated critically.

COMMENTS ON OLDER HEARING TESTS

Mackenzie [10] feels that the older methods for testing hearing are presented because of their unsurpassed value in the diagnosis of diseases of the ear and because they are being neglected by newer methods (notably the audiometer) which have become popular out of all proportion to their real value. The history and otoscopic observations are dependable in about 75 per cent of the cases, whereas the functional hearing tests are dependable in about 100 per cent, providing the examiner knows his instruments and knows how to use them. The functional hearing tests with the tuning forks comprise a method for detecting mixed forms of deafness which is a vital factor in determining the worth of a diagnostic value in otologic problems.

Quantitative tests are of little value in determining the location of the lesion, since the amount of the loss in hearing is more dependent on the intensity of the pathologic process than on its location. Attention should be directed toward determining the character of the deafness; for example, by the quality of the Rinné or Schwabach reactions, since the nature of the deafness shows the location of the lesion.

Hearing by bone conduction is improved in obstructive deafness because the sound waves which ordinarily escape by way of the external canal and eustachian tube are prevented from doing so, thus resulting in a proportionate increase in volume of sound waves reaching the inner ear. In obstructive deafness, the gain in hearing by bone conduction is about equal to the loss by air conduction, with most of the gain on the affected side. It is impossible to make a purely unilateral bone conduction test, so that the hearing represents the total of the function of the two ears.

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10. Mackenzie, George W.: The Older Methods for Testing Hearing, Ann. Otol. Rhin. & Laryng. **36**:100 (March) 1927.

A thoroughly accurate diagnosis in disease of the ear includes the determination of the site of the lesion or qualitative diagnosis, the character of the lesion or pathologic diagnosis, the intensity of the changes or the degree of involvement as found in a quantitative diagnosis, and the primary cause or etiologic diagnosis, and the qualitative diagnosis is the most important. The etiologic and pathologic diagnoses are hardly less valuable, whereas the quantitative diagnosis is the least important; one of these often helps in determining the others. It may be necessary to call on specialists in other branches of medicine in order to make an accurate diagnosis. The determination of the location of the pathologic lesion or lesions in or about the ear must be made by the otologist, who cannot do so without the aid of functional hearing tests properly conducted. The common errors in making the functional fork tests are due to: (1) lack of knowledge of the pitch of the fork used in making the tests; (2) lack of knowledge of the length of time the tuning fork vibrates audibly for the normal hearing ear both by air and by bone conduction; (3) lack of attention to the position in which the fork is held while the air conduction test is being made; (4) lack of attention to the normal fatigue of the end-organ; (5) indifference to the manner in which the fork is applied to the mastoid when the bone conduction test is being made; (6) lack of knowledge as to whether the control hears normally or not, and (7) lack of attention to the age of the control as compared with that of the person being examined.

The determination of the location of a lesion or lesions responsible for the impairment of hearing has not been as consistent with the use of the audiometer alone as with the use of the fork tests alone. This is due to the fact that the audiometer cannot eliminate bone conduction while making air conduction tests; also the bone conduction is bilateral, and in view of the borrowing and loaning of bone conduction from one side to the other, the interpretation of the results becomes difficult, especially in unilateral and mixed forms of deafness. These handicaps are least evident in the bilateral cases, which are the ones most commonly presented in the literature. Furthermore, the higher the tones used the farther the carrying power, with the greater likelihood of cross-conduction taking place.

The advocates of the audiometer believe, first, that they have an instrument for testing quantitatively audition at different pitches which when plotted gives results sufficiently characteristic to indicate diagnosis; secondly, that the tuning forks are less accurate and therefore less reliable. The advocates of the tuning fork methods contend that the most important object to be attained in the diagnosis is that of locating the lesion or lesions responsible for the deafness, and that this is more likely to be possible with the qualitative tests, such as the

Weber, Schwabach and Rinne tests in which both air and bone conduction are compared, than by the use of quantitative tests, as with the audiometer. Investigators have attempted at different times to use the quantitative tests with the continuous series of forks, but even under ideal conditions they have abandoned them for the more certain qualitative methods.

The article is accompanied by a series of illustrations and graphs to show the effect of various lesions on bone conduction, the borrowing and loaning of bone conduction from one side to the other, and the character of fork of the response to the tuning fork test in mixed forms of deafness.

The purpose of functional testing [11] is to determine the presence and degree of impaired hearing, if any, and to determine the location of the defect. In the examination of the functions of hearing, the voice, acoumeter, watch, Koenig rods, tuning forks, resonators, whistles monochord and audiometers are employed. Observation of the patient is an important factor with reference to the loudness of his voice, attitude of the head, lip reading and other factors. The otoscopic examination includes a careful inspection of the external ear, the tympanic membrane and region of the mastoid, the nasal, nasopharyngeal and pharyngeal regions. When testing with the voice by means of unaccentuated whisper or conversation, the patient's eyes are closed or averted and the opposite ear occluded. High and low tones and combinations of both should be used. After inflation of the ears, tests are again made with the voice.

Tuning forks are used largely to determine the upper and lower tone limits, as well as to carry out the Schwabach, Weber, Rinne and other tests. The prongs of the fork move in transverse vibrations of great amplitude but slight intensity, while from the stem arise longitudinal vibrations of great intensity but small amplitude. Testing for the low limit begins with a C-2 (16 double vibrations) fork and proceeds upward. For high tones, C-4 (1,028 double vibrations) and C-5 (4,096 double vibrations) forks are used. For still higher tones, a modification of the Galton whistle, such as the Edelmann-Galton or Schaefer-Galton, is used; or, best of all, the monochord, with which the highest tones may be tested both by air and by bone conduction.

The Weber test for the determination of the lateralization of sound to one ear or the other is made by placing the fork in the median line of the vertex, forehead or root of the nose. Normally, the sound is heard best in the head, but is lateralized to the ear in which the hearing

11. Sonnenschein, Robert: The Philosophy of the Older Tests of Hearing, Laryngoscope **37**:393 (June) 1927.

is most defective with impairment of the conduction apparatus and to the better hearing ear with involvement of the inner ear. There are, however, many exceptions to this rule.

The Schwabach test is used for determination of the duration of bone conduction in the individual as compared with a normal living control. The fork is placed in the median line of the vertex or on the mastoid. Slight diminution or slight increase is not significant. As a rule, there is a definite lengthening of bone conduction with involvement of the middle ear apparatus, and a decided shortening thereof with impairment of the inner ear. The Rinne test used for comparison of air with bone conduction in the same person is in many ways the most valuable of the tuning fork tests. The stem of the fork is placed on the mastoid, and when no longer heard, a prong is held close to the ear without touching the auricle or vibrissae, and the duration of hearing by air is noted. Normally the Rinne test is positive, that is to say, air conduction is of longer duration than bone conduction. In involvement of the perception apparatus, the Rinne test is also positive, but both air and bone conduction are shorter than normal. With involvement of the conduction apparatus, the Rinne test is usually negative, that is, the duration of bone conduction is longer than that of air conduction. There are about eight varieties of the Rinne test.

The Gellè test is used for determining the mobility of the footplate of the stapes. Normally, with compression of the air in the external auditory canal there is diminution of hearing if the fork is placed on the head and the tuning of the bulb connected with the external auditory canal. If there is a decided fixation of stapes, a change in hearing does not occur.

The Stenger test is used for unmasking simulation of total unilateral deafness. Two forks are employed simultaneously, the patient believing only one is used. One fork is moved somewhat closer to one ear, and the other fork vibrates at the opposite ear so that the sound of the nearer fork drowns out the sound entering the opposite ear.

The Weber, Schwabach and Rinne tests are the most important, and should be used in every case. The Gellè and Stenger tests are for special purposes, and if desired, one may employ several other tests, such as the Politzer for determining patency of the eustachian tube, the Bing test for determining the change in bone conduction, and the Lucae-Dennert test for noting the difference of hearing in the open and the closed meatus.

Audiometers are used for quantitative tests and for obtaining audiograms which give a graphic record, showing loss of hearing in sensation units. When forks are supplied with "constant" of damping or decre-

ment, similar curves are obtained, but if many pitches are tested, the process is more tedious than with the audiometer. On the other hand, forks are less expensive, and the instrumentarium more easily transportable.

Hallpike [12] presents a practical method of charting the auditory fields by means of a graph. Air conduction is first determined by a comparison of the patient's ability to hear the forks with that of the observer, whose hearing is presumably normal. Similarly, bone conduction is tested with forks applied to the mastoid, with occlusion of the meatus of both patient and observer, in order to obtain conditions as equable as possible. The third procedure is the obtaining of the ratio of air to bone conduction, as compared with that of a normal person. These are shown graphically by using the seconds as the ordinates and the various forks as the abscissae. Two lines are first drawn, representing the normal air and bone conduction for the various forks. The patient's air conduction is expressed in relation to the normal, the value for each fork being shown in the graph as so many seconds above or below the normal line. By joining the levels for each fork, a curve is obtained showing a diminished or increased air conduction, depending on the location of the curve as compared with the normal curve. The bone conduction curve is obtained in a similar manner, and thus a graphic presentation of the degree of disturbance of the normal relationship of air to bone conduction is quantitatively expressed.

Fowler [13] states that the older standard tests are not intrinsically wrong, but some difficulties arise on account of their careless use and interpretation, the excessive time required, the lack of space, the need of a quiet place and the variation between instruments. The sensation unit as used with the audiogram is a definite unit of measure which has a common meaning for all otologists that is a decided advantage over the older tests of hearing which have none. The audiometers require but a few minutes for an accurate estimate of the hearing at the frequencies which the different machines cover. The voice test, watch test, acoumeter and coin click may be approximately measured in sensation units, but the difficulties attending their correct employment are so many that they are only occasionally available for practical purposes.

A diagnosis of deafness of the nerve cannot be made from the audiograms alone, except in certain extreme cases; neither can such a diagnosis be made with tuning forks, by air conduction alone. A receiver attachment for the audiometer for bone conduction has just been per-

12. Hallpike, C. S.: Suggested Graphic Method of Representing the Tuning Fork Tests, J. Laryng. & Otol. **42**:322 (May) 1927.

13. Fowler, Edmund Prince: The Newer Tests for Hearing with Demonstration of Methods, Laryngoscope **37**:285 (April) 1927.

fected which appears to be reliable. Dr. Fowler checks up the audiometer results with tuning fork tests from 64 double vibrations to 2,048 double vibrations for both air and bone conduction, using calibrated forks measured in sensation units of which an audiogram can be made. His method of performing the tuning fork test is to strike the fork a standard blow, one of considerable force being most satisfactory, and then to place the side of the extremity of one prong opposite the auricle. As soon as the patient signals whether or not he hears it, the shank of the fork is immediately placed perpendicularly and firmly on the mastoid about three quarters of an inch behind the meatus. Alternate placement of the fork before the mastoid and on the mastoid are made every three seconds until the patient ceases to hear any sound by both air and bone conduction. Approximately the same ratio of loss is obtained in the sound of the fork both by air conduction and by bone conduction. If the fork is calibrated, the amount of loss in hearing for both air and bone conduction can be easily determined in the same units of measure, and an audiogram of the hearing can be constructed as accurately as when the 2 A audiometer is used. A sufficient number of tests at each frequency and enough care must be employed to eliminate error. The audiometer has two distinct advantages for research work over tuning forks, namely, its greater range of frequencies and its greater range of intensities. The latter is over twice that of the best forks.

Fowler believes that the new tests are not essential for the purpose of making a diagnosis in the great majority of cases. Their continued use may show that former methods have been somewhat faulty, and with the aid of the new appliances a better understanding will be obtained of the functions of the mechanism of the ear in health and in disease. The article is accompanied by audiograms illustrating various types of deafness.

THE RINNE TEST

I have written an article [14] based largely on several of my earlier papers. Among these were: "A Suggestion Regarding the Rinne Test," June, 1916; "A Study of the Rinne Test in One Hundred Cases," March, 1922; "The Use of the Tuning Fork Stem for Both Air and Bone Conduction in the Rinne Test," by Dr. Minton and myself, in March, 1923.

I think that the Rinne test is probably the most valuable of all the tuning fork tests in that it shows whether the lesion is localized in the

14. Sonnenschen, Robert A.: A Study of the Rinne Test with Special Reference to the Use of the Fork Stem for Both Air and Bone Conduction, Beitr. z. Anat. Physiol. Path. u. Therap. d. Ohres. **25**:153, 1927.

inner ear, middle ear or in both. At the same time, if desired, it is possible to use the bone conduction factor of the Rinne test instead of the Schwabach as usually employed.

Attention is called to the fact that normally air conduction is much greater than bone conduction when the tests are performed in the usual manner. This ratio is known as the positive response to the Rinne test: one may have the same relation in cases of disease of the auditory nerve, but in these cases both factors are usually shorter than the normal. When bone conduction is of longer duration than air conduction, there is the so-called negative response to the Rinne test, and here there are also three varieties, depending on the lesion. If the usual conditions of the middle ear are present or if the inner ear is also involved, this will cause a change in the ratio of the two factors. There is also the so-called indifferent or plus-minus response to the Rinne test when both air and bone conduction are of the same duration, and when the length or rather the duration of both factors may vary; this depends on whether a slight tubal involvement is present, or whether there is also involvement of the inner ear. Finally, there is the so-called "infinitely" negative response to the Rinne test in which there is no hearing of the fork by air, and only slight duration of hearing by bone; this is found in far advanced lesions of the nerve.

In employing the stem of the tuning fork both for bone and air conduction, the bone conduction was first tested by applying the stem of the fork to the mastoid process in the usual manner; when it was no longer heard, it was inserted into a rubber tube which had a length of 51 cm., a lumen of 0.7 cm. and a wall 1.5 mm. thick. At the other end of the tube was an olive-shaped, hard rubber, perforated tip which was inserted into the external auditory meatus. After the test by this procedure, it was found that the ratio between air and bone conduction was practically the same as when the Rinne test was performed in the ordinary manner by testing the bone conduction with the stem and the air conduction with the prongs of the fork.

A careful search of the literature was made, but a definite reference to the use of the stem of the tuning fork for both air and bone conduction was not found prior to the publication of this paper; since then, however, attention has been called to work of this character by Bruehl and Stefanini. The methods employed, however, were somewhat different from those used by Minton and me; we performed also a number of physical experiments to prove that the sound waves reached the ear by means of air conduction only through the lumen of the tube and not through the walls thereof, thus disposing of the objection offered that there was a possibility that the sound was conveyed to the ear by bone conduction through the contact of the rubber tubing or tip.

APPARATUS FOR TESTING OF HEARING

Griessman [15] cites the great interest shown in the apparatus he first presented in 1921, and which has been improved since then. According to him, from the physicist's standpoint there are no insurmountable difficulties in the way of the construction of an instrument which can be used for testing hearing.

Griessman notes the defects of tuning forks, such as their overtones, their damped vibrations and the fact that the amplitude cannot be kept constant, and hence the impossibility of keeping the tone at a desired intensity for any length of time. The requirements of an ideal and accurate hearing device are: that it must cover the whole tone range, the tones must be pure, and the intensity from the threshold to the loudest sounds must be capable of being produced and sustained. Minimum intensity necessary for audition can be determined, and a chart of hearing can be constructed.

The apparatus includes an alternating current generator, a filter to get a pure sine curve vibration, electrical resistances to control the volume and a telephone receiver. The tone range is from 80 to 2,800 cycles a second. All frequencies and intensities can be duplicated. The apparatus gives more sound at some frequencies than at others, owing to the characteristics of the telephone receiver. This appliance must resemble audiometers in some ways, but is not comparable to them in the range of frequencies which the latter are capable of delivering.

Flatau [16] briefly describes a "new" hearing apparatus for the most advanced impairment of hearing, with emphasis on the fact that by means of one or more vacuum tubes great amplification of sound is possible.

Every one knows that such types of hearing aids have been constructed and used in this country, but Flatau evidently is unaware of this fact, and thus believes, as the title announces, that his is a "new" device.

Anthon and Fiek [17] describe an apparatus in which vacuum tube oscillators (or a sort of Geissler tube) are used apparently in much the same manner as the audiometers in this country. They believe that with the special form given their telephone receiver, bone as well as air conduction of sounds is possible.

It is strange that the American types are not mentioned. This is, however, "in line" with my experience in reading the continental medical

15. Griessman, B.: Accurate Hearing Tests with the Otoaudion, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:333 (Oct.) 1926.

16. Flatau: A New Hearing Apparatus for the Most Advanced Impairment of Hearing, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:340 (Oct.) 1926.

17. Anthon and Fiek: A New Electrical Device for Accurate Clinical Testing of Hearing, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:336 (Oct.) 1926.

literature. Either because of lack of funds wherewith to buy American journals or because of failure of sufficient interest in what is being done here, many European workers seem to be almost wholly ignorant of the splendid contributions of American otolaryngological literature. The excellent *Zentralblatt für Hals-, Nasen- und Ohrenheilkunde* gives abstracts of practically all medical literature (English, French, German, etc.), so that German speaking otolaryngologists may keep informed of progress elsewhere.

Banister [18] makes a survey of the evidence for the assumption that air-borne sounds communicated to one ear in the normal manner can be transmitted through the head to the other ear. A brief survey of the previous work on this subject is made from Cappivaccius in 1509 to that of Stewart in 1922. He performed a difference tone experiment, using an apparatus in which the tones were produced by telephones in oscillating circuits transmitted through two separated insulated circuits which led to a mixing chamber and then to binaural tubes. By means of stopcocks, either sound could be transmitted to one or both ears, or the two sounds separately one to each ear, or the two sounds mixed together by both ears or to one ear only. The tones used had frequencies of 879 and 763 double vibrations per second, so that the first difference tone was a low note of 116 double vibrations per second. The two notes were first given separately and then together, and the patients were told that they were to listen particularly for the difference tone and to sing the pitch of it. Five subjects were experimented on, and none could discern a difference note when the tones were led separately to the ears. However, when one of the binaurals was removed and a feebly vibrating tuning fork was held with its stem pressed against the bony frame of the head while an appropriate tone was led to the ears through the remaining binaural, a difference tone was discriminated in that ear. Difference tones could not be heard when notes of suitable frequencies were led to the ears separately and simultaneously. Conclusions to be drawn depend on whether the tympanum or the cochlea is regarded as the normal seat of difference tones. Adherents of the former theory would agree that the experiment shows that the tympanum was not set into vibration by sounds which had been transmitted through the head, but that it by no means rules out the possibility of sounds being transmitted through the head from the ear to the cochlea on the other side. Adherents of the other theory would consider the evidence as being more antagonistic still to any hypothesis of the transmission of sound through the head. It might be more correct to say that some sound is conducted through the head, but

18. Banister, H.: The Transmission of Sound through the Head, London, Edinburgh and Dublin Philosophical Magazine **2**:144 (July) 1926.

the amount is relatively small, and that in consequence, the difference tone produced at the tympanum is so weak that it cannot be appreciated. Banister mentions the phenomenon of crossed resonance and is unable to give an explanation for it. He states that "little or no reliable experimental evidence has so far been obtained to support the hypothesis that aerial borne sound waves of normal intensity which reach one ear through the auditory meatus are transmitted through the head to the other ear. Till transmission has been proved, it is rather previous to consider how the vibrations are initiated, and whether the transmission takes place through the bones, sinuses, soft parts of the head or through any combination of these."

Herzog,[19] formerly a follower of Bezold's theory that there is no such thing as conduction of sound purely by bone, has changed his view. Small mirrors were fastened at various places on the conduction apparatus and on the temporal bone transferring to a kymograph the vibrations induced by a tuning fork. These experiments did not support the Bezold theory of exclusively craniotympanic conduction, but rather strongly indicated direct transmission of an appreciable volume of vibrations from the bony walls of the labyrinth to the perilymph. Therefore, two sets of vibrations are transmitted to the sensory epithelium—those directly from the bony walls of the labyrinth and those via the membrana tympani, ossicular chain and footplate of the stapes. It was found that the latter are slightly delayed behind those directly through the bone, thus giving a slight difference in phase, which is believed to cause a damping and therefore a lessening of hearing by bone via the ossicular chain. If the latter chain is fixed, the vibrations direct from the bony wall are unhindered and strengthened and the stimulus to the sense organ is increased (increased bone conduction), giving lateralization to the diseased side.

Another test described is as follows: Two ends of a U tube filled with water are closed by membranes; on one of these is set a tappet to imitate the stapes footplate. It was found that the more the movement of the stapes was limited, the stronger were the vibrations caused by a vibrating tuning fork placed against the tube and perceived at the "round window."

INVESTIGATIONS ON CRANIAL RESONANCE

Démétriades[20] has continued the work of investigating cranial resonance published and reviewed a year ago, this time paying special

19. Herzog, H.: The Bone Conduction Problem: Theoretical Consideration, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:300 (Oct.) 1926.

20. Démétriades, D.: Cranial Resonance in Brain Tumors and Its Relation to the Aural Findings, Ztschr. f. d. ges. Neurol. u. Psychiat. **107**:184, 1927.

attention to cases of tumors of the brain. Of these, some were verified by operation. Among Démétriades' conclusions are:

1. The determination of cranial resonance is important for otology and neurology, but is of value only when the whole picture of the symptoms of the ear and nose is complete.

2. It is necessary to have the relation of the cranial resonance to the labyrinth so that one may supplement the other.

3. In diseases of the central nervous system, especially if tumor is suspected, the minimal stimulation (Kobrak) of the labyrinth should be employed.

4. There is better resonance on the side where the tumor of the brain exists, and the Weber reaction in the author's cases was usually lateralized to the diseased side. Hypoirritability or hyperirritability of the labyrinth is usually found more developed on the side of the tumor.

5. The more pronounced resonance is usually on the side having the more developed choked disk, and this, together with the previous conclusions, gives a symptom complex often noted in tumors of the brain.

6. These various symptoms are primarily due to vasodilation, since unilateral dilation of blood vessels has been shown to give increased resonance on that side.

Birkholz [21] used forks A (108 double vibrations) and a-1 (435 double vibrations) and avoided all possibility of suggestion in his testing of the cranial resonance, basing his work on that of Goldberger-Schoen published in 1925. The a-1 fork was not placed on the head until it was no longer sounding loud by air conduction. The author came to the following conclusions:

1. In normal cases, when the Weber test is made, the sound is usually heard "in the head" with the fork on the vertex. With the fork in the parietal region, crossed perception is rarely noted. Practically the same result was obtained when the fork was placed at the root of the nose as when it was placed on the vertex.

With forks resting above the inner canthus of the eye, there was crossed resonance in 50 per cent and homolateralization in the other 50 per cent. These results were noted with the a-1 fork; with the A fork, the results were much more indefinite.

2. When there was the slightest involvement of the middle ear, there was lateralization to the diseased side, no matter where the forks were placed. There was no crossed resonance when the forks were placed on the inner canthus. With distinct unilateral deafness, the sound was always heard in the well ear, no matter what the position of the forks was.

3. The author could not find definite lateralization to the side of the diseased sinuses in any case in which the nasal accessory sinuses were diseased.

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21. Birkholz, Dozent: Crossed Perception of Tuning Fork Tones by Bone Conduction under Physiological and Pathological Conditions, Ztschr. f. Laryng., Rhinologie, Otologie und ihre Grenzgebiete **15**:224, 1927.

Temporal bones [22] freshly removed from a cadaver were fastened in a Broemer vise. Then either the tympanum was opened from above, the hammer bands being left intact and a mirror of 2.5 mm. diameter, 1 mm. thickness, fastened to the hammer head, or, after removal of the labyrinth, a similar mirror was fastened to the labyrinthine side of the footplate of the stapes. The beam of light was transmitted through a crack to a film running on a kymograph. At the same time, another mirror was fastened to the upper pyramid angle or to the plate of the vise parallel to the ossicular mirror, and its light beam similarly registered. The contra A fork was used to produce the vibrations. According to Frank, the elasticity coefficient of the ear of a fresh cadaver is about the same as that of the living ear. Frank and Broemser have calculated that the inertia moment of the ossicular chain is increased 1 per cent by the mirror; by removal of the labyrinth, it is decreased about 10 per cent.

1. Under "normal" conditions, the curves show that the ossicular chain vibrates with greater amplitude than the temporal bone. The phase differs from one tenth to one twentieth of a wave length.

2. Closure of the external canal showed that the amplitude of the chain was relatively increased; the phase difference was as already noted. If one assumes that this is due to greater movement of labyrinth fluid, it explains the increased loudness of bone conduction on closure of the external canal.

3. Increased air pressure in the external canal gave decreased amplitude of the chain, and the phase difference disappeared. Increased bone conduction was attributed to the disappearance of phase difference.

4. The canal was filled with mercury; the phase difference disappeared and the amplitude of the chain increased. Both components combine to increase fluid movement and represent the optimal hearing effect. In the living, this experiment gives greatly increased bone conduction.

5. The canal was filled with water; the amplitude of the chain greatly increased the phase difference to one fourth of a wave length. In the living, result was as in the previous experiment. It is believed that the greater amplitude (and therefore the fluid movement) is sufficient to overcome the phase difference. In the Gelle test the sudden compression of air in the canal compresses the air in the closed tympanum, thus restricting the movement of both windows and decreasing the hearing.

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22. Krainz: The Problem of Bone Conduction: Experimental Data, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:306 (Oct.) 1926.

One may say that amplitude difference alone improves and that phase difference alone decreases hearing. But both are operative at the same time, and as one or the other outweighs, the hearing is affected; the best hearing is when both moments coincide.

The human ear is plainly designed principally for air conduction. The essential physical construction of the conduction apparatus (its moment of inertia and elasticity coefficient) is to be looked on as inhibiting hearing by bone conduction.

Considering clinical experience and experimental data, that changes in the outer and middle ear influence hearing, and that under these conditions transmission through the solid labyrinth walls per se remains unchanged, it may be said that the kind and nature of the vibrations of the ossicular chain have a definite influence on the hearing via bone conduction.

Claus [23] in particular checked up the claims of Goldberger and Schoen that disease of the anterior group of paranasal sinuses, with normal ears, gives lateralization of the sound of the tuning fork (placed in the median line) to the diseased side. He credits Luace with the first observation that the resonance chambers of the head influence lateralization (1886). He quotes Urbantschitsch to the effect that lateralization of normal ears may differ from two nearby points in the median line; and quotes Blegvad that lateralization may take place even with normal ears.

His conclusions are that people with small or absent frontal sinuses do not lateralize to the side of such sinuses; as a rule, patients with unilateral frontal, maxillary sinusitis or pansinusitis do not lateralize to that side, and when this does occur, it is traceable to tubal or tympanic changes. Experiments made during operations showed that a polyp or blood filled cavity did not influence lateralization; neither did unilateral narrowing or closure of the nasal passage by septal deviation, polyps, hypertrophy or synechie or by tamponade, have any such effect.

Claus did not experiment with regard to disease of the sphenoid, but says he is unable to agree with Goldberger and Schoen.

It has often been pointed out by many others and by me that the Weber test is the least reliable one of the major tuning fork tests, and that because of the many exceptions to the rules of lateralization which may be found, it is of real value only when it agrees with and confirms the clinical observations.

I have published a review of the recent literature [24] on cranial resonance, which included special reference to the work of Claus, Runge,

23. Claus: The Influence of the Nose and Paranasal Sinuses on the Weber Test, Ztschr. f. Hals-, Nasen- u. Ohrenh. **15**:441 (Oct.) 1926.

24. Sonnenschein, Robert: Recent Literature on Cranial Resonance and its Clinical Application, Ann. Otol. Rhin. & Laryng. **36**:454 (June) 1927.

Démétriades, Schoen and Goldberger, Cohn and Nussbaum, and Claus. The principles involved in the Runge test are similar to those in the Bing test in which the finger is inserted into the external canal to determine whether an increase in bone conduction is produced. Some writers have remarked about the necessity to differentiate between resonance of the various cavities of the skull and bone conduction. "A resonator responds to any source of sound which has the same natural frequency as its own, whereas the bone itself responds to forced vibrations if the mass has not the same frequency as the vibrating mechanism such as tuning fork."

The clinical application of the double phonendoscope test involving the principles of diagonal or crossed resonance of the skull is still doubtful and requires many more tests by many observers. Nevertheless, certain points should be considered which may indicate a few fallacies as observed by the writer in the tests he has made, namely:

1. In the first place, it is most essential that the examiner's ears be normal or that he knows definitely his own defect.

2. Even normal persons may have considerable difficulty in noting a lateralization of sound to one or another part of the head. This fact, brought out long ago with reference to the Weber test, well known to otologists, emphasizes that it is difficult for many persons to realize that a sound has been lateralized, and if so, to which side. Many persons on whom the Weber test is performed show a lateralization from the median line of the skull, even though both ears are apparently functioning normally, and conversely, a person who has a lesion in one ear may refer the sound to the middle of the head or to the opposite ear. As far as is known, no definite explanation has ever been offered for these variations.

3. In the third place, depending on the point at which the fork is placed in testing the sinuses, especially in reference to the ethmoids, markedly varying results are noted, with a difference of only a few millimeters in the point at which the fork rests; therefore, the results must be noted with great caution, since the lateralization is so easily influenced.

4. When there are bilateral lesions of the ears, the results are confusing to the examiner. If one ear or the other shows a combination of involvement of the inner and middle ear, the question of diagonal resonance is at times indefinite or contradictory, and the results difficult to interpret, at least when one's experience is limited.

5. One should recall the fact that vibrations may traverse the cranium without being perceived, as was stated by Bezold long ago.

6. Variations in the intensity of striking the forks sometimes gave changes in lateralization.

The older otologists, such as Lucae, Politzer, Urbantschitsch and others, who have performed similar tests, should not be forgotten. It appears to me that the standard fundamental tests when properly performed and combined with a complete clinical examination will give sufficient data for diagnosis of the state of hearing. Should the newer tests, however, furnish additional information, they also should be utilized to the fullest possible extent.

SYMPTOMS OF PARACUSIS WILLISI

Shambaugh [25] states that paracusis willisi is observed apparently when the deafness is bilateral, of a fairly marked degree and due to obstruction in the conduction mechanism. It is usually limited to the spoken voice, becomes more conspicuous as the deafness progresses, and is persistent in those cases in which there is an accompanying secondary degeneration of the eighth nerve.

There are two possible explanations for this symptom. The first is that extraneous noises increase the acuteness in the response of the hearing mechanism, either by temporarily overcoming the rigidity of the conducting mechanism or by stimulating the end-organ of hearing, but these hypotheses do not seem correct. The rigidity of the conducting mechanism in cases in which there is marked paracusis is usually due to ankylosis of the stapes which cannot be loosened to a great degree by any method, and if extraneous noises stimulate the end-organ of hearing, paracusis would be present in other types of deafness as well as when hearing is normal. The second explanation is that paracusis is only apparent, owing to the involuntary raising of the normal person's voice to overcome extraneous noises.

Shambaugh carried out two series of experiments, using the Western Electric 2 A audiometer with padded ear pieces and perforated ear pieces. The subjects included those with normal hearing, those with otosclerosis and those with conduction deafness. The tests were conducted on a train while at the station and while it was in motion. Shambaugh concludes that persons with normal hearing show an impairment throughout the tone range, especially for the lower tones when in the midst of extraneous sounds. A defective hearing resulting in fixation of the stapes is not improved in the presence of extraneous sounds, but may show an increase in the defect. Persons with normal hearing using the open ear pieces while riding on a train showed a defect in hearing for the audiometer in the lower and middle tone ranges as marked as that of the person with advanced deafness resulting from otosclerosis. "The symptom of paracusis willisi is not produced

25. Shambaugh, George E.: Explanation for the Symptoms of Paracusis Willisi, Arch. Otol. **6**:228 (Sept.) 1927.

because the deafened person hears better in noisy surroundings, but is dependent on the increased difficulty of hearing which the person with normal hearing experiences in the presence of a noise. The increased difficulty in hearing for all tones, including the voice, which the normal person experiences in the presence of noise results in an effort, more or less unconscious, to raise his voice sufficiently to overcome this handicap. The person who is deaf because of fixation does not experience an increased handicap in the presence of extraneous sounds, since his deafness for the low tones effectually shuts out most of these extraneous noises. In noisy surroundings, therefore, the actual handicap experienced from obstructive deafness may even be less than that experienced by the normal person, because of the confusion created by extraneous sounds. This explains why a deafened person will often hear the voice better than one with normal hearing, for example, while riding on the train."

This paper is an interesting contribution to the knowledge of paracusis willisi.

29 E. Madison Street, Chicago.

News and Comment

MEETING OF FIRST INTERNATIONAL OTO-RHINO-LARYNGOLOGICAL CONGRESS

The first International Oto-Rhino-Laryngological Congress will meet at Copenhagen, from July 29 to Aug. 1, 1928. The president of the congress is Prof. E. Schmiegelow.

Abstracts from Current Literature

Ear

OTITIS MEDIA IN INFANTS. DEAN M. LIERLE, Ann. Otol. Rhin. & Laryng. **36:** 604, 1927.

A syndrome of intestinal disturbances produced by otitis media in infants has frequently been described during the past two or three years. This relationship has been observed and reported by many different otologists and pediatricians, who, in general, conclude that an otitis media may be accompanied by disturbances of nutrition as evidenced by dyspepsia and emaciation; that on evacuation of the contents of the middle ear, disturbances in digestion disappeared and an increase in weight followed; that elevations in temperature occurring with intestinal disturbances might be referred to complications of otitis, and that in all intestinal infections of infants accompanied by elevations in temperature and reduction in weight, an examination of the ears for the possible presence of otitis should not be neglected. Acute nutritional disturbances in infants, associated with diarrhea, fever, hydrolability and toxic symptoms are often not the result of intestinal infections or of food poisoning, and it is concluded that there must be some metabolic disturbance or a toxemia of an infectious nature.

Lierle reported a group of 130 cases examined and studied during a period of four years. He found that infections of the tympanum and mastoid are apparently secondary to infection in the nose and throat. A diagnosis of paranasal sinus disease was made in all but six cases of this series during the last two years. Ninety-two patients had involvement in both ears. Spontaneous rupture of the drum membrane occurred in twelve. The majority of the cases presented slight pathologic change in the drumhead. The luster was usually gone, and the membrane appeared dirty white, gray or a dirty yellow. Paracentesis frequently did not reveal pus or serum in the middle ear, but on opening the mastoid antrum a definite amount of pus was found often under much increased tension. The predominating organism in these cases was the hemolytic streptococcus.

Formerly, many of these infants died without being suspected of having any involvement in the ears or sinuses until it was disclosed at autopsy. The large numbers disclosed at autopsy is what has given impetus to the work on this subject in recent years. The prognosis depends on the duration and character of the infection, as well as on the presence of other systemic complications. The virulence of the organism is a large factor in the prognosis. The author makes a plea for the close cooperation between the otologist and the pediatrician in the handling of these cases, as acute otitis media in infants is rarely an otologic problem alone.

TUBERCULOSIS OF THE MIDDLE EAR WITH ESPECIAL REFERENCE TO HELIOTHERAPY. S. J. CHAPMAN, Ann. Otol. Rhin. & Laryng. **36:**631, 1927.

The frequency with which tuberculosis of the middle ear occurs varies somewhat in different localities. In sanatorium practice in Colorado, where the author made his observations, there are usually from four to six cases among one hundred tuberculous patients. The preponderance of the author's cases has been in adults suffering from pulmonary tuberculosis, although some other investigators find the infection much more commonly in children. St. Clair Thompson states that among 700 cases seen in three years at a tuberculosis sanatorium, only two revealed chronic suppurative otitis media which he regarded as tuberculous. In a survey of 300 cases of pulmonary tuberculosis, Goldsmith found none of the patients suffering from tuberculous otitis media.

The route of infection may be by the eustachian tube or through the blood and lymph stream. The form of nourishment in children apparently plays an important rôle. Unboiled cow's milk may be a source, or children may be infected by tuberculous mothers.

The onset is usually insidious, the first evidence of its presence often being a slight aural discharge. Pain is rarely present. The inflammation of the drum membrane is of low grade with little redness, and the discharge is seropurulent and scant, becoming thicker and more purulent later. Mastoid tenderness is rarely seen, except in the presence of a mixed infection. Facial paralysis is a fairly common complication. The diagnosis is made from the characteristic onset, the observations on the middle ear, the chronicity, the presence of an adjacent or remote tuberculous focus, the finding of bacilli in the aural discharge by smear or by inoculations into guinea-pig and by pathologic examination of excised tissue. Smears of the pus rarely show tubercle bacilli.

When tuberculous otitis media is suspected, the author believes it best not to open the drum membrane unless rupture threatens, because occasionally such a case will go on to resolution. Most cases progress to suppuration within from a few days to a few weeks. Simple cleansing of the canal with irrigations and applicators is sometimes sufficient to clear up certain cases. Heliotherapy is of definite value and worthy of a thorough trial in the chronic cases, except when the pulmonary condition is active and when there is a moderate elevation in temperature. In such instances, the condition of the lung is of prime importance and should receive first consideration. It is not the author's custom to use local or general heliotherapy in febrile cases. The treatment consists of reflected sunlight by means of a modified solar laryngoscope, such as was originally devised for the treatment of patients with laryngeal tuberculosis, and is now in general use for that purpose. With practice, the patient can learn to see the tympanic membrane clearly and can aid in his own treatment by watching the progress. He is directed to take a half minute exposure once or twice daily and increase a half minute a day up to fifteen or twenty minutes. The results have been encouraging. In some patients the middle ear became dry without healing of the perforation, and in others there was complete healing with closure of the perforation.

SNAPP, GRAND RAPIDS, MICH.

THE RELATION OF THE SENSORY HAIRS OF CORTI'S ORGAN TO THE MEMBRANA TECTORIA. HANS HELD, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:169 (Aug. 27) 1927.

Hensen's view that the sensory hairs merely touch the lower surface of the tectorial membrane is generally accepted. The great majority of investigators agree with him on account of the result of many painstaking observations. Held considers Wittmaack's view untenable when he says that the sensory hairs of the inner hair cell are bent at a right angle and enter the basal layer of the tectorial membrane. Held also claims that the existence of a cementing substance between the sensory hairs and the membrane has not been proved. Furthermore, the sensory hairs and the fibers of the tectorial membrane are two entirely different formations which develop from different types of cells. Held examined some of the slides given to him by Wittmaack after he had stained them with molybdenum-hematoxylin. The author furnishes eight microphotographs to prove his assertion, and calls attention to the manner in which artefacts are created and lead to deceptive conclusions.

ORIGIN OF CHOLESTEATOMA IN THE RABBIT. J. H. NIENHUIS, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:186 (Aug. 27) 1927.

1. A circumscribed cholesteatoma was accidentally found superimposed on a chronic inflammation of the middle ear and canal.

2. The manner of development corresponded with that in those forms of cholesteatoma which have been described in man (Manasse, Lange, Hellmann).

3. The squamous epithelium had destroyed the cylinder epithelium by growing from the depth toward the surface of the epithelium without bringing to the fore inflammatory processes. After the squamous epithelium had reached the surface, it tended to proliferate under the cylinder epithelium, whereby the latter perished through disturbances of nutrition or pressure.

4. Proliferation of squamous epithelium had created cholesteatoma in polyps of the mucous membrane.

5. In this instance, reasons were advanced which supported the opinion that the development of cholesteatoma must be attributed to a change in the nature of the squamous epithelium cells in the canal of the outer ear.

AMBERG, Detroit.

Pharynx

SENSORY AND TROPHIC DISTURBANCES OF THE PHARYNX; OSTEO-ARTHRITIS DEFORMANS OF THE CERVICAL VERTEBRA. J. TERRACOL, Arch. internat. de laryngol. otol. rhinol. et broncho-oesophagoscopy **6**:1025 (Nov.) 1927.

The author deals with that perplexing group of patients who have a multitude of symptoms and complaints referred to the pharynx and tongue with little if any physical symptoms. The average consultant prefers to classify this unfortunate group of patients as hysterical, and thus they drift from one laryngologist to another. These patients are about or past middle age; they complain of symptoms localized either about the tongue or in the region of the tonsils and of difficulty in swallowing, a condition which disappears during eating; others have cancerphobia.

Examination is usually easy to perform. Enlargement of the lingual tonsils or varicosities at the base of the tongue may be found. The mucosa of the pharynx is usually atrophic, but the faucial tonsils may appear normal. On the whole, there is an abundance of symptoms with a scarcity of pathologic changes.

The author calls attention to the anatomy and pathology of the cervical vertebral column, and in particular to the osteo-arthritis that may occur. He reminds us of the work already done in other regions of the column for relief in conditions such as lumbago, localized paresis and dystrophies, and contends that the same condition may occur in the cervical column. He calls particular attention to the vertebral artery, which is almost entirely intra-osseous in this locality. The nervous elements, the glossopharyngeal, the vagus and the cervical sympathetic nerves, are in close relation to either the osseous column or its ligaments and muscles. The intervertebral foramen gives passage to the sympathetic fibers of the spinal nerves, spinal vessels and lymphatics; the author does not, however, stress the pathologic processes of the foramen as the most important feature.

He groups the pathologic processes under the osseous and ligamentous lesions, which he believes are due to an "upset in the physiochemical equilibrium in the colloids constituting the interstitial plasma." The skeleton serves not only as a framework, but as a calcium reserve of the body, and at times this reserve is called on, resulting in rarefaction of the bone. Vasomotor disturbances and endocrine imbalance seem to play an important rôle in this condition. Calcification of the perivertebral structures results from edema of the connective tissue, which causes it to revert to the embryonal type; infiltration takes place and finally calcification.

The characteristic symptoms produced by changes in and about the cervical vertebrae are:

1. Pain in the pharynx due mostly to involvement of the vagus and cervical sympathetic nerves and pain at the base of the tongue caused by involvement of the glossopharyngeal nerve.

2. Motor disturbances, usually difficulty in swallowing, due to atrophy of the superior constrictor muscle, which is enervated by the glossopharyngeal nerve.

3. Sensory involvement, chiefly of the papilla at the base of the tongue which are supplied by the glossopharyngeal nerve.

4. Reflex pain because the pharyngeal reflex is under the control of the glossopharyngeal nerve.

5. Psychic symptoms.

The treatment is not entirely satisfactory. Local applications give only transitory if any results. Surgical measures are experimental. Physiotherapy, especially the roentgen-ray treatment and diathermia, give the best results.

J. H. Roth, Kankakee.

Complications of Peritonsillar Processes. Georg Kelemen, Ztschr. f. Hals- Nasen- u. Ohrenh. **19**:180 (Aug. 27) 1927.

A man, aged 20, suffered from an abscess on the left side of the throat which raised the sternocleidomastoid muscle. This abscess had developed in consequence of, or simultaneously with, a peripharyngeal or retropharyngeal phlegmon. By lifting the upper pole of the tonsil, pus was evacuated, while the abscess in the neck was attacked by a free incision along the posterior border of the muscle. The patient recovered quickly. All blood cultures were negative. A piece of the muscle removed and examined histologically showed, according to the detailed report of Professor Entz, far-reaching destruction of muscle tissue. Uffenorde reported the results of the examination of some tissue in the region under similar circumstances, without mentioning the nature of the tissue, and Zange reported the examination of the posterior facial vein. Zange found thick balls of fibrin which he considered a sign of a beginning thrombosis or of a propagation of a thrombophlebitis situated posterior to the tonsil. In Kelemen's patient, the extensively congested capillaries were everywhere surrounded by a ring of white blood cells which formed a successful dam against the flooding of the circulation. The propagation in the muscle occurred along the lymph spaces. Thrombi were not found in the tissue of the author's patient. This explains the mildness of the case. The trial excision could be an important guide, because, as Zange says, the diagnosis should be made in the beginning, and not at the end, of the process. Biopsy also directs the surgical procedure. Zange demands free exposure and closure of the wound with the healthy tissue. Kelemen demands previous histologic examination of the tissue. If a vessel should be covered by a lymphangiotic muscle, thrombosis might occur. The softening of the muscular tissue may explain why muscular tissue loses its hemostatic qualities in spontaneous hemorrhage. Trial excision may also assist in solving the question whether the jugular vein should be ligated. The studies of the author showed that in his patient this was only one of the pathways of propagation. Fraenkel justified the ligature of the jugular vein theoretically, but admitted the unsatisfactory results. All pathways cannot be blocked and the exclusion of only one pathway is not sufficient. A greater conservativeness in the practice of ligating the jugular vein is indicated by the healing of the extremely grave destructions in Kelemen's patient. These destructions have been observed only post mortem.

Amberg, Detroit.

Larynx

Submucous Exenteration of the Larynx as a Therapeutic Measure in Definitive Stenosis. A. Sercer, Rev. de laryngol., no. 17, September 15, 1927, p. 545.

The term definitive stenosis of the larynx is here meant to describe a condition remaining after the biologic reaction of the causative process has been completely terminated. It does not include acute or chronic inflammations, neoplasms or traumatism.

The stenosis is divided into four types. In the first type, there is paralysis of the recurrent laryngeal with the vocal cords in the median position; in the second type, the cords are in a median position, and there is ankylosis of the arycricoid articulation; in the third type, cicatrization of the interior soft parts occurs and in the fourth type, partial resorption or destruction of the cartilages causes collapse of the vocal box.

The technic of the operation is as follows: A local anesthetic of from 10 to 20 per cent of cocaine is applied to the pharynx and larynx and a regional anesthetic of 0.5 per cent of procaine is applied in the line of the incision and along the superior laryngeal nerves. A narcotic with atropine may be employed. A soft rubber tube is inserted through the nose to the hypopharynx to aspirate saliva and blood from the field of operation.

An incision is made along the length of the thyroid cricoid and the first ring of the trachea. When the larynx has been opened, a tampon of cocaine epinephrine is placed inside the larynx to complete the anesthesia. For extirpation of the vocal cords, an incision is made along the anterior wall of the larynx and along the vocal cords, a dissection is carried down to the perichondrium, and the cords are removed. The remaining mucosa is brought together with fine catgut sutures. The author calls this his partial submucous exenteration of the larynx.

In the total exenteration, an incision is made along the ventricular bands, and the entire ventricle of Morgagni with its subordinate structures is dissected out. The cavity in both operations is packed with iodoform gauze. The larynx remains open, and the interior of the cavity is always under control until cicatrization is complete. When the surgeon is convinced that the patient is able to breathe freely, the opening is closed and the tracheotomy tube removed.

As a rule, the patients seek relief from the embarrassment of the tracheal cannula. Some authorities recommend cordectomy, while others condemn the procedure on account of the subsequent closure by cicatrization. The author contends that submucous exenteration and control through the external opening eliminates the complication.

The author reported two cases of laryngeal stenosis following typhoid and one following tuberculosis. In the first case, three months following a tracheotomy for rapid suffocation, during abdominal typhoid fever, the patient presented himself for relief from the tracheotomy tube. The vocal cords and the arytenoids were in the median position and fixed. At first only one cord was extirpated, but later this was found unsatisfactory for free respiration; so after some weeks the other cord was removed. This allowed free respiration, and the vocal function was fairly well taken care of by the ventricular bands.

The second case followed typhoid fever during which a tracheotomy had been performed. After seven years, the patient sought relief from the tracheal cannula. A total exenteration of the larynx was performed, but it was found that the pharynx was collapsed because of the partial resorption of the cricoid. In order to repair this defect, a graft from the sternum was used. An incision 7 cm. long was made on each side of the sternum, and a piece of the sternum, 6 cm. long, 2.5 cm. wide and from 3 to 4 mm. thick, was elevated. The skin from each side was tucked back under and sutured beneath the elevated bone, remaining intact by two pedicles above and below. The skin on each side of the sternum was drawn together beneath the elevated flap. Fifteen days later, the lower pedicle of the flap was severed, and at the end of another fifteen days, the flap was swung upward to close the defect in the larynx. Functional results were good. The patient breathed freely and comfortably at all times, and vocal function, which was relatively good, was carried on by the aryepiglottis.

The third patient had been treated for years for laryngeal tuberculosis. He was finally forced to wear a tracheotomy tube. A total exenteration was

accomplished, and pathologic observations revealed recent tuberculous infiltrations in tissues cicatrized for a long time.

The author finds that patients usually seek relief from the embarrassment of the tracheal cannula. The operation effectually accomplishes this result, and at the same time gives the patient a better speaking voice than he had with the tracheal cannula in place.

J. H. Roth, Kankakee.

Nose

The Anatomic, Pathologic and Clinical Relationship of the Posterior Sinuses to Optic Neuritis. Claude G. Crane, Ann. Otol. Rhin. & Laryng. **36**:201, 1927.

Much has been written in recent years concerning the relationship of the nasal sinuses to optic neuritis. Crane has made an extensive review of the literature on this subject up to the present, and he emphasizes the importance of early operative procedures in many of these cases. While retrobulbar neuritis secondary to sinus disease is now an accepted clinical fact, it is obvious that there is a considerable difference in opinion concerning the exact pathologic nature of the involvement of the nerve. Just what the pathway is that is followed by the active agents and in what manner the pathologic change develops in the nerve are questions that have not been answered satisfactorily. The main difficulty in solving these problems lies in the absence of postmortem studies in any given case. These patients do not die, and the future does not hold great hope that we may be able to study even a small number of these cases at autopsy. Up to the last few years the theory has been accepted that the invasion of the nerve was by contiguity, the inflammation spreading to the nerve structure by direct extension. More recently the toxic idea of involvement has received more attention, and it is at present accepted by some as a better conception of the pathologic condition in a great majority of the cases. It is well known that any focus of infection may cause an optic neuritis just as readily as it may cause a neuritis of any other nerve. When the optic nerve is involved in this way, however, the results are serious, due to pressure within the optic canal.

The posterior sinuses are the ones most usually involved in these cases, the posterior ethmoidal cell being the one of greatest importance. This cell may replace the sphenoid in relation and in position and be the etiologic factor. This point should be kept in mind during all operative procedures on these patients, for it is imperative that the posterior-superior angle of the ethmoid capsule should be completely exenterated. The area may consist of a single large cell, or it may comprise several smaller ones. Every cell in this region, including the sphenoid, must be opened and drained sufficiently to afford permanent ventilation. The postoperative care should aim to prevent the growth of granulation tissue or the formation of scar tissue which may in any way lessen the desired result; namely, complete and permanent ventilation of the posterior ethmoidosphenoidal area. The author emphasizes that operative measures should be instituted without delay for all such cases in which a known cause other than possible sinus disease cannot be determined. Conservative measures may be attempted but should not be persisted in unless immediate benefit results therefrom.

The Origin of Otogenous Sinus Thrombosis. T. Huenermann, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:127 (Aug. 27) 1927.

A woman, aged 24, who had suffered from a discharge from the left ear for eight weeks previous to Nov. 24, 1926, was admitted to the clinic on account of severe pain, dizziness and vomiting. A profuse discharge and a pulsating light reflex were noticed. The mastoid process was moderately tender on pressure, and a throbbing sensation was present. She said that she had

a dull sensation of pressure in the anterior temporal region. Her neck was not stiff and she did not have spontaneous nystagmus. The roentgen-ray examination showed a pronounced arrest of pneumatization, but there were some cells in the region of the upper angle of the sinus.

A day after admission the temperature rose to 103.3 F. following a chill. Operation was performed immediately and revealed a diploic mastoid process and single small cells with spongy masses of mucous membrane. Through broken-down bone the dura of the middle fossa was encountered. Further exposure revealed a large vessel of the dura which was covered with granulations. It could be followed for about 2 cm. toward the sinus. Pus emanated from the vessel. On exposure, the sinus looked normal, and in the bone covering it, there were not any apparent changes. In order to learn the connection between the large vessel of the dura and the sinus, the wedge of bone between the middle and posterior cranial fossa was carefully removed. The vessel entered the sinus at its upper angle and was torn from the sinus without bleeding. Four days after the operation, a chill occurred. The jugular vein was tied, and the sinus was evacuated. On December 20, the patient was discharged well.

Koerner, to whom the case was described, was of the opinion that, possibly a persistent petrosquamosal sinus had presented itself, such as Kramm, Habermann and Jansen had reported. In the new-born, the petrosquamosal sinus lies in the still open fissure between the two bones which form the roof of the tympanic cavity. As a rule, it develops into a suture or disappears entirely. According to Koerner, the petrosquamosal sinus extends from the upper angle of the transverse sinus at the floor of the middle cranial fossa forward, perforates the squamous portion of the temporal bone closely behind the glenoid fossa and ends in a deep temporal vein. A petrosquamosal vein is frequently found. Habermann found an isolated thrombus in this vein only once, at necropsy, in an old person who died of suppurative bronchitis and pleuritis after refusing an operation. Kramm found a similar condition at necropsy and expressed the opinion that in his patient the sigmoid sinus should have been packed to the angle in order to prevent the entrance of infectious material from the vessels on the roof of the tympanic cavity. Furthermore, he demanded that the tegmen antri be removed and the dura be inspected in all cases of a hidden wallstanding thrombus, especially when the surface of the sinus appeared normal, or, if the bone on the posterior wall of the mastoid process was not diseased. Great attention should be paid to the tegmen antri if the mastoid process shows an arrest of pneumatization. Thus, lasting anatomic changes can be produced, so that, even in advanced age, a broad petrosquamosal suture may be present and a more pronounced development of the vein. It is surprising that thrombosis of the petrosquamosal sinus is not described more frequently in the literature. It will be found more often if it is looked for in cases of unexplained otogenous general infection.

The author recommends a roentgen-ray examination of the mastoid process before operation in order to determine the location of the pneumatic spaces and the sigmoid sinus.

CEPHALOCELE INTRANASALIS. WILHELM EDEL, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:163 (Aug. 27) 1927.

A boy, aged 18, was said to have suffered from nasal polyps soon after birth. These were removed first when he was 9 months old. A continuous watery discharge from the nose was reported. Polyps were removed repeatedly, until a greater intervention under general anesthesia, during his fourth year, gave the patient relief. He suffered frequently from severe headache, especially above the nose. During these attacks, he acted dishonestly and even committed burglaries, whereas at other times he was industrious, kind hearted and intelligent. Examination revealed the fact that the left side of the nose was almost completely filled with a grayish-white smooth tumor with a shining

surface. The roentgenogram showed absence of frontal sinuses and cloudiness of both ethmoids and of the left maxillary antrum. A portion of the tumor was removed for examination. A probe, carefully introduced, entered the cranial cavity without resistance. The specimen contained tissue of the central nervous system with a covering of connective tissue. Five days later, the patient complained of headache; six days later, in addition, he suffered pain while swallowing, and, during the following night, he vomited. The next day, the patient was restless and dazed, and showed a positive Kernig sign. An operation was performed according to the Jansen-Ritter technic, and the frontal lobe of the brain was elevated in order to reach the sac of the hernia, which was extending into the nasal cavity through an opening, 1.5 by 1 cm., in the lamina cribrosa. The sac was joined to the bone at its posterior border; also to the septum. Respiration became difficult, and the patient died on the operating table. Necropsy was not permitted.

Intranasal encephaloceles have been observed by Richter, Cruveilhier, von Meyer, Fenger, Kayser, Schoetz, Nager, Froboese and Lenhoff. Only one patient (Fenger's) or, perhaps, two (Lenhoff's), survived an operation. Nevertheless, surgical intervention is contraindicated. The diagnosis is difficult. Only Nager diagnosed his case without operation; he, however, made a trial puncture, a procedure which might not always be harmless. One should consider the possibility of intranasal encephalocele and resort to trial puncture rather than to trial excision or trial snaring if the anamnesis, appearance, compressability, transillumination, roentgen-ray examination and irrigation of the maxillary sinus do not lead to a diagnosis.

AMBERG, Detroit.

Miscellaneous

CONSIDERATIONS OF THE ETIOLOGY OF FACIAL PARALYSIS—"A FRIGORE." R. CAUSEE, Ann. d. mal. de l'oreille, du larynx. **46**:973 (Oct.) 1927.

The observations in two cases were reported. Paralysis of the face came on suddenly without pain, deafness or vertigo. The Wassermann reaction was positive, and under antisyphilitic treatment the patient improved, but contracture resulted. After six months, examination showed normal hearing but perverted vestibular response.

The second case resembled the other, except that vertigo and hemicrania accompanied the onset of the facial paralysis. The Wassermann reaction was negative, but the condition improved under antisyphilitic treatment. The paralysis and pain were relieved, but contracture resulted. Hearing and all reflexes were normal, with the exception of perverted vestibular response.

The author believes that facial paralysis complicated by involvement only of the vestibular division of the eighth nerve is a rare combination, but might not seem so rare if more vestibular tests were made in cases of paralysis of the facial nerve. He does not agree with Gelle that facial paralysis, "a frigore," is always of auditory origin. While the cause cannot be ascertained in all cases, he believes that syphilitic meningitis and herpes zoster should be considered.

J. H. ROTH, Kankakee.

PHYSIOLOGY AND PATHOLOGY OF THE RESPIRATORY ORGANS: IV. MOISTENING OF THE SURFACE OF THE MUCOUS MEMBRANE UNDER NORMAL AND PATHOLOGIC CONDITIONS, ESPECIALLY IN FUNCTIONAL DISTURBANCES (RHINITIS VASOMOTORIA, ASTHMA BRONCHIALE, ETC.). HERMANN STERNBERG, Ztschr. f. Hals-, Nasen- u. Ohrenh. **19**:104 (Aug. 27) 1927.

In addition to the secretion of the glands and the epithelium of the surface, the transudation from the mucous membrane toward the surface is important. The moistening of the surface of the respiratory organs serves mainly to prevent the drying up of the surface by the passing current of air. Disturbances of this transudation are important factors in the etiology and in the mechanics,

respectively, of the so-called vasomotor diseases of the mucous membrane (hydrorrhea nasalis, rhinitis vasomotoria, asthma bronchiale, secretory catarrh of the tube and middle ear, etc.). The tendency of the secretion to dry up and to form crusts is the consequence of insufficient transudation, because the secretion of mucus by the glands and the surface epithelium does not become diluted sufficiently.

The cocaine-epinephrine-coryza has been utilized, unconsciously, for a long time. After the primary effect, cocaine and epinephrine increase the transudation and favorably influence lysis in the inflamed and infiltrated tissue and in engorgement of the mucous membrane of the nose and the accessory cavities during acute inflammation.

AMBERG. Detroit.

Book Reviews

NASAL NEUROLOGY. HEADACHES AND EYE DISORDERS. By GREENFIELD SLUDER. Price, $11.50. Pp. 428, with 167 illustrations. St. Louis: C. V. Mosby Company, 1927.

This treatise includes a rediscussion of problems presented in an earlier publication in 1918 concerning headaches and disorders of the eyes of nasal origin.

The problems discussed are among the most difficult to evaluate in clinical medicine. This book should be carefully read by every one undertaking to practice in the field of rhinology. There is much in it to command serious attention. It is a philosophic discussion of some of the newer problems in this special field. The author is to be complimented on his masterful presentation of details and his suggestive speculations. The book is sure to attract attention to some of the complex problems in rhinology. It should be read especially by those who have had sufficient background in clinical experience to be able to evaluate for themselves the problems discussed in it. Its perusal by the untrained "specialist" is capable of doing a world of harm, for it apparently leaves wide the door for indiscriminate nasal operations in the effort to relieve a great variety of nervous disorders which are difficult, if not impossible, of explanation.

The author begins with a presentation of his philosophy regarding vacuum headaches, a hypothetic condition the existence of which many experienced rhinologists have not been able to verify. The author presents his arguments, pathologic and clinical, to account for pain in the region of the frontal sinus in which palpable evidence of disease of the sinus is not present. The fact that this particular type of headache combined with "Ewing sign," a point of tenderness in the upper angle of the orbit, has been repeatedly observed when the roentgenogram demonstrates the complete absence of a frontal sinus rather discredits the whole theory of the occurrence of vacuum headaches. The author fails to discuss the most palpable objection to the theory of vacuum in the sinus as the cause for protracted headache. The objection is, that if a vacuum should occur from an obstruction in the outlet of a sinus, it would promptly be relieved by the sinus filling with fluid, which should, of course, end the headache.

In his discussion of the pathologic condition supposed to be responsible for the closure of the nasal frontal passage, as well as the condition supposed to be responsible for much of the phenomenon of neuralgias and disorders of the eyes, the author postulates the presence of a hyperplastic process involving the nasal membranes as well as the underlying bone; he connects this with the well-known hyperplastic processes which not infrequently involve the ethmoid. The author has undertaken to establish this hypothesis through the assistance of the histologic study of fragments of tissue removed from these patients and which he has submitted to Jonathan Wright for histologic study. The experienced clinician will at once inquire why this condition, which to him is intangible, undiagnosable and nonsuppurative, is always to be found in patients with neurologic syndromes, whereas these peculiar syndromes are practically never observed in those cases in which palpable, tangible evidence of the well known hyperplastic process with formation of polypi is demonstrable. If there were any real foundation for the hypothesis of vacuum headaches, one could certainly expect to find these headaches to be the rule in those cases in which the nasal cavities are found tightly obstructed with

the formation of polypi. As a matter of fact, headache is not one of the symptoms of which these patients complain.

The author's discussion of hyperplastic sphenoiditis would leave one with the impression that a great many varieties of nervous syndromes, including headache and serious ocular disturbances, result from a nonsecretory, intangible undiagnosed and, to most physicians, undiagnosable hyperplastic alteration in the sphenoid region and that relief of these syndromes is to be looked for in surgical procedures. The explanations that the author offers for complicated clinical phenomena are equalled only by the intricacy of the anatomic relations in the nasal chambers. The author endeavors to find an anatomicopathologic basis for each of the many forms of syndrome which he believes to have a nasal origin. He goes into these complexes with great detail, but leaves the impression that the subject has not begun to be exhausted and that such complexes are practically limitless. After all, the impression left is that these hypotheses are not unlike the theory of nasal reflexes which swept many rhinologists off their feet in the latter half of the last century, led some to believe that there was scarcely any human ailment that could not be explained as the result of nasal reflexes, and opened the door for all sorts of indiscriminate nasal operations. Rhinologists today discredit most of the conclusions that were accepted by those of the earlier generation and are inclined to look askance at most of the cures of nasal syndromes attributed to tinkering operations in the nasal cavities.

One can follow the author readily through only some of his statements regarding disease of the sinuses and ocular complications. I agree with him when he states that the mucous membranes of the nasal passages, as well as of the accessory sinuses, are so frequently involved in acute inflammatory processes that one should be prepared often to find evidences of inflammatory changes in the form of hyperplasias, and also of atrophy, in both of these localities. However, in the treatment of these chronic conditions, it would seem as logical to propose denuding the nasal passages of their altered membranes as to advise denuding the accessory cavities of their lining membranes. One thing that the treatment of patients with such diseases of the sinuses requires, which is not a factor in the treatment of the nasal passages, is the securing of drainage for pent-up secretions and of providing proper ventilation for the diseased cavities. When this has been accomplished, about all has been done that it is possible to do for patients with these chronic alterations that involve the membranes lining the sinuses. It is to be expected that in many of the chronic cases the alterations in the membranes may persist indefinitely, as do the chronic alterations in the membranes lining the nasal passages. The persistence of altered secretions from such sinuses does not have a clinical significance different from the indefinite persistence of the pathologic secretions from the altered membranes lining the nasal passages. It is exactly what one expects, and only cleansing treatment is required.

When ocular complications develop as the result of disease of the sinus, it seems logical to believe that such complications may be influenced favorably by surgical treatment when pent up secretions can be relieved by such measures. If one goes further and assumes that ocular disturbances and other neuroses may result from a nonsecretory, hyperplastic process, it seems doubtful that surgical measures will alter such disturbances; when these disturbances disappear subsequent to surgical treatment and when palpable evidence of pent up secretions is not disclosed, it seems as logical to believe that this relief has occurred in spite of surgical measures as that it results from the operation. There does not appear to be any great need for assuming that degenerative processes involving the optic nerve, not otherwise accounted for must be explained by the proximity of the optic nerve to the ethmoid and sphenoid cavities. The same type of change occurs with equal frequency in the eighth nerve, which does not encroach on any pneumatic spaces.

ANATOMISCHE UNTERSUCHUNGEN ÜBER DIE TUBERKULOSE DER OBEREN LUFTWEGE. VON PAUL MANASSE, M.D. Price, 9.90 marks. Pp. 101, with illustrations. Berlin: Julius Springer, 1927.

This is a monograph of 101 pages and represents the author's studies in preparing a report for the German Congress of Nose, Throat, and Ear Specialists, held in Hamburg in 1926. It is amply illustrated with drawings of gross and microscopic preparations, both in black and white and in colors, and gives a complete account of various types of tuberculous involvement in the upper air passages. It is a valuable contribution to our knowledge of tuberculosis of the respiratory tract.

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